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OF

GENITO-URINARY ORGANS

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OF

GENITO-URINARY ORGANS

BY

J. W. S. GOULEY, M.D.

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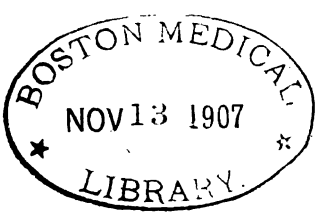

To

THE MEMORY OF L. AUGUSTE MERCIER, D. M. P.,

AS A TOKEN OF HIGH APPRECIATION OF HIS VALUABLE CONTRIBUTIONS TO THE NATURE AND THERAPY OF DISORDERS OF THE GENITO-URINARY ORGANS, AND AS A MARK OF GRATEFUL REMEMBRANCE OF HIS KINDNESS, AND OF ESTEEM FOR HIS CHARACTER, THESE PAGES ARE REVERENTLY INSCRIBED

PREFACE

THIS work consists of brief annotations on the nature, diagnosis and treatment of some of the diseases of the genito-urinary organs that come within the province of surgery. These informal notes are designed to place before the profession the results of the writer's own researches as well as those of other laborers in the same field of science, hoping that they may be of practical utility to beginners.

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SURGERY
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I

CATHETERS, BOUGIES AND SOUNDS

1. In view of the very frequent employment of metallic and non-metallic tools for the diagnosis and treatment of urinary disorders, it has seemed consistent to begin these notes with such bits of practical information as could be gathered respecting the nature, care, and uses of these instruments.

2. The occurrence of retention of urine was probably the first occasion for the acquirement of some knowledge of the treatment of obstructed urination. It is more than likely that one of the earliest sufferers, having seen others in the throes of strangury and dying in great agony, conceived the idea of improvising an instrument with which to relieve his own painfully distended bladder, and with that purpose doubtless selected and suitably fashioned a straight, smooth, hollow reed and coaxed it into the urethra farther and farther until the urine flowed freely. Such success must have led him to advise other sufferers to follow his example and so, for many ages thereafter, the only catheters were probably hollow reeds

or other adaptable vegetable products. It does not appear that metallic catheters came into use for the relief of retention until after the Hippocratic era.

3. For the benefit of beginners, it may be well, before going any farther, to premise a short account of the history, nature, names, uses, and care of some of the instruments employed for catheterism. Of this history, young physicians need to learn enough to be cautious in their assertions and in their claims to new inventions or modifications, and thus elude the literary fangs of the captious critic, or escape many acrimonious controversies. Of the nature, names, uses, and care of surgical instruments, the knowledge of hospital internes is sadly deficient, and ordinarily they care little for instruction in these particulars. The consequence is that ill-used instruments are soon cast away or relegated to the cutler into whose hands they are too often delivered in a hopelessly damaged condition. Consistency in asepticism and success in treatment demand that the young physician shall know how to take proper care of his instruments, besides understanding their principles of construction and action, and being able to put together, for immediate use, those composed of several parts, and to dismount them for cleansing. Some surgical works indicate the manner of accomplishing these purposes, but object lessons are indispensable. Therefore, the interne should frequently visit the surgical arsenal, examine the instruments with care, take some of them apart and remount them, from time to time, until he shall have acquired the needed knowledge.

4. Hollow tools for drawing urine from the bladder were evidently devised long before the invention of the

solid cylinders designed to dilate the urethra or to sound for stone. The original catheters, as already said, were probably straight reeds, and it must have been a very long time before metallic cylinders were thought of; the idea of curvature probably being the outcome of frequent failures with straight instruments. The first authentic account of curved hollow cylinders was given by Celsus, who described them as copper pipes of a length of fifteen fingers' breadth, and gave directions for their use in ridding the bladder of accumulated urine. Good examples of these curved metal tubes were unearthed from the ruins of Pompeii.*

5. The word catheter was employed by Hippocrates to signify any kind of tent for introduction into fistulous tracts following wounds, but the hollow cylinder for drawing urine from the bladder is not mentioned by that encyclopedic writer; it was, however, latinised by the Romans and is used in some of their works to signify an instrument for drawing urine, also named *fistula*, or *syringa*, a pipe. They used the word *specillum*, which is equivalent to probe, for what in English is now named a sound, and *catheter* for the tubular instrument designed to empty the bladder. For probe, the Spanish use the word *tienta* from *tentare*, to search into. Catheter literally means a thing to let down or put in, from

*A kind friend purchased, at Naples, and gave to the writer, an excellent *replica* of one of the curved Pompeiian copper or bronze catheters. It shows the sigmoid figure (adopted by Petit two centuries ago); the single eye appears to be rectangular and is two millimeters in breadth, six millimeters in length, beginning at seven millimeters from the point, along the inner aspect of the curve and not on the side as is the catheter eye of the present time; the vesical extremity, for a centimeter, is conical; the shaft is thirty centimeters in length, and the caliber six millimeters and a half—equal to No. 10 of the English scale.

kata, down, and *ienai*, to send; or from *kathienai*, to introduce, to send down. *Sonda*, sound, is from *subundare*, to submerge—*sub*, under, and *unda*, a wave. *Algalie* and *algalia*, used by the French and Spanish, are from the vulgar Latin *argalia*, from the vulgar Greek *argaleion*, which is corrupted from the classic Greek *ergaleion*, meaning a tool, an instrument.

6. It is evident that the terms sound, catheter, and *algalia* do not imply that these instruments are solid, hollow, or even cylindric, or that the catheter or *algalia* is intended to draw off any fluid; therefore, these arbitrary names are absolutely inexpressive, but, by general consent among the English-speaking people, are employed to signify the one a solid cylinder, the other two, hollow cylinders. Aside from the inappropriateness of the names employed to designate these instruments they are too often confounded, owing to a lack of general consensus among nations as to what should be the precise designation of each instrument. Solid metal rods are used to sound the bladder, but hollow cylinders are also used for the same purpose. A catheter, in the English sense, is often employed as a stone searcher, but a sound, in the same sense, can not be utilized in drawing urine, since it is a solid rod, intended to dilate the strictured urethra as well as to sound for stone. As already noted, these terms are used in entirely different senses by several nations, notably the French, Italian, and Spanish, who call *sonde*, *sonda*, *algalia*, the instrument named catheter by the German, English, and American nations. It is hoped that more distinctive and accurate names will eventually be given to these tools, but the question of rightly naming them can only

be settled on a proper basis by duly delegated persons representing the medical profession of the nations. For the present, in English, let it be understood that *catheter* is intended to designate an instrument for drawing fluid from a cavity, and *sound*, an instrument for sounding and for dilating.

7. Catheters and other tools designed for "putting into" the urethra and bladder should be examined with reference to the substances of which they are composed, to their form, to their caliber, to their cavity, to their apertures, to their curvature, to their length, to the shape of their proximal and distal extremities, and to their adaptation to the particular uses to which they are destined. This study is of much importance, in consideration of the fact that catheterism is performed so often and for so many purposes besides drawing off urine.

8. The composition of catheters has a long and interesting history of which, however, a brief abstract only is needed for the purposes of this note. It has already been said that tubes for drawing urine from the bladder were originally non-metallic; that the precise time when metals, such as copper or bronze, were first employed in their construction is unknown; and that perhaps the earliest written evidence of the use of metallic catheters is from Celsus; but they were in common use before his time. The metals afterward employed in the fabrication of catheters were lead, tin, silver, and gold, and very recently German silver and aluminum bronze. The urethral false routes so frequently made by incautious catheterists with rigid metallic cylinders induced surgeons to devise divers means to avert the danger,

without thinking that these accidents were owing more to the performer than to the instrument. Leaden catheters were used in the ninth century by Rhazes on account, as he believed, of their adaptability to such forms as might be suggested by contortions of the diseased urethra. Later, narrow bands of silver twisted spirally were made into catheters. Of such material, the spiral catheter of Solingen (1684) covered with leather, and the vermicular catheter of Roncalli (1741) were made. From the times of Solingen and of Roncalli the same principle of action of these catheters has been carried out by many surgeons, and nearly all spiral or vermicular instruments have been described as new inventions.*

9. In the beginning of the eleventh century, Avicenna used soft catheters made of the skins of different animals, coated with some sort of varnish to protect them from the action of the urine. Fabricius of Acquapendente was the inventor of horn catheters and of others made of bands of linen coated with wax. Catheters of chamois and dogs' skins were used by Van Helmont and by Troja. Those of ivory-gelatin, prepared by immersion in dilute hydrochloric acid, were invented in 1832 by Cazenave, of Bordeaux, who, in 1842, read a paper on the subject before the Paris Academy of Medicine. These catheters were used by few surgeons besides Cazenave, and are now regarded as mere curiosities, although the inventor strove to revive their use by publishing, in 1875, an extended essay on their merits.

*Several years ago Dr. Stuart Eldridge, of Yokohama, gave the writer an admirably worked spiral catheter made, it was supposed, by a Japanese artizan—when, the donor could not ascertain.

10. Of the soft instruments styled "gum catheters," something should be said relating not only to their evolution but to their properties and general characters. One of the first hints, though not the earliest essay, emanates from Herissant who, in 1763, suggested that India rubber dissolved in ether might be used with advantage in the fabrication of catheters and bougies, and Thedn, of Berlin, carried out the idea by coating silken cylinders with an elastic varnish dissolved in ether. Cazenave gave a formula of the varnish for coating soft catheters but did not say whether it was ever employed by Laserre or by any of the other manufacturers of so-called gum instruments. It is as follows: "One part of linseed oil boiled with litharge, one third of a part of succinum, one fourth of a part of oil of turpentine, and one twentieth of a part of India rubber." In 1779, Bernard, a jeweler of Paris, presented to the Academy of Surgery soft, flexible catheters and bougies made by him with the object of substituting them for metallic and wax instruments. These catheters and bougies were then called gum-elastic instruments, and are still styled in France *instruments en gomme*, but it was soon ascertained that no India rubber entered into their composition. They were made of a silk fabric coated with boiled linseed oil, and dried and polished. Dr. Pickel, of Wurzburg (1785), published the following formula for making the varnish of the so-called gum instruments: "One part of melted succinum, one part of oil of turpentine, and three parts of common cabinet-maker's varnish which consists of linseed oil boiled with white litharge, subcarbonate of lead, red oxide of lead, or sugar of lead." This mixture was

used to coat catheters or bougies of silk fabric. After three such coats the instruments were dried in an oven at a temperature of 70° F. for twelve hours and then polished with pumice. It afterward received from fifteen to eighteen more coatings and was dried and finally polished with tripoli. This process has since been variously modified, simplified, and improved; some of the makers using entirely different coatings, several of which contained none of the substances mentioned in Pickel's formula. The exact nature of the divers processes of catheter and bougie making now employed in France, Germany, England, and America, is not known, because each manufacturer has secrets of his own in the way of braiding the cylinders, in the composition of the material for coating the braid and in the manner of its application, in the method of polishing, and in the time consumed for the perfection of the products of his industry.

11. The interior of every catheter should be as thoroughly coated and nearly as smooth as the exterior, otherwise it is soon fouled by the urine and infected with micro-organisms. The best quality of silk should be used in the preparation of the cylinders and the braid should not be too close. The coating should be translucent and highly elastic, and should not be so thick as to render the braid invisible.

12. Great quantities of inferior catheters and bougies are still imported and sold in different parts of this country. Their framework is of cotton coated with a varnish which soon hardens and becomes so brittle as to crack transversely all along the shaft; each crack being a fit lodgment for colonies of bacteria besides being a point of election for fracture.

13. Trials with divers kinds of flexible web catheters, treated with ordinary care, have given results worth recording. Lisle-thread and "silken-linen" catheters, after being used fifteen or twenty times, often show many transverse cracks close together in a space extending from eight to twelve centimeters from the eye, and are thereby rendered unfit for further use; whilst in many instances good silk catheters used several times every day were free from cracks and in good condition after having been used two and even three hundred times. Physicians and patients will find it to their advantage to decline purchasing any but the best silk-web catheters; for though the first cost is nearly double that of the others, they are so much more durable than the Lisle-thread or "silken-linen" instruments that in the end they are the cheapest and least liable to break, while they can, without injury, be readily disinfected by means of formaldehyde vapor. It should be noted that nearly all web-catheters harden when kept idle for a long time, and are to be cast away as soon as they lose their suppleness, for it is then that they are most liable to break during introduction or withdrawal. For use in warm climates a special coating is given to catheters and bougies; otherwise, they stick together firmly and are thus spoiled, even when dusted with talc.

14. The silk-web and the India-rubber catheters have replaced very advantageously the metallic for drawing off urine, and few physicians think themselves warranted in using for that purpose instruments of metal or of any other rigid substance, except in certain conditions of the urethra requiring catheterism upon a conductor, or in cases of false routes relievable by Mercier's invagi-

nated catheter. The so-called prostatic (silver) catheter, with extraordinary curve and length, is a thing of the past which—with all due respect and veneration to Sir Benjamin—seems as if it had been intended for a urethral lacerator and prostatic plough, although, in good hands, it has often passed into the bladder without causing serious injury. The ordinary curved, elbowed, and double-elbowed web-catheters, which average thirty-five centimeters in length, answer well for drawing urine in cases of the very largest prostates; it may therefore be said in all fairness that the so-called prostatic web-catheter of exaggerated curve is unnecessary if not worse than useless. The writer has never seen a single case which he could think required the use of such an unsightly and unhandy instrument.

15. All sorts of fanciful catheters of silk, ramie, silken-linen, or cotton-web, or of caoutchouc with wings or other projections near the vesical end, have been invented during the past thirty-five years, and soon rejected as worse than useless. One of these, in the writer's collection of confiscated catheteric curiosities, is of vulcanised grayish India rubber with a rich golden-yellow raw-silk thread wound spirally around the whole shaft—suggesting a fit habitat for millions of tiny organisms. The length of this extraordinary catheter is thirty-nine centimeters, its diameter is 6.5 millimeters, its countersunk eye is blind, for it had never been cut open, and it is probably the only specimen that had ever been prepared. Those who invent such accessories do so with the idea of remedying the flimsiness of thin-walled catheters, whereas the desired object is so simply accomplished by giving each instrument sufficiently

thick walls without material interference with the needed caliber of its lumen.

16. The properties of good web-catheters may be stated as follows: These instruments are thoroughly, but not too thickly, coated with varnish inside as well as outside, and are highly polished; the varnish is pliable, not apt to crack for a long time, and resists the action of moist heat up to the boiling point;* in length, they need not exceed thirty-three centimeters; they vary in diameter from three to nine millimeters; the distal extremity of their single oval eye is one centimeter from the point which is smooth and rounded; this eye, in curved,† elbowed, and double-elbowed catheters, is generally lateral, but in some of these instruments the eye is superior and corresponds to the concavity of the bend, and in other cases the eye is omitted, the catheter being open at both ends, or, in addition to the eye, the vesical end is left open for catheterism upon a whalebone conductor. The better qualities of web-catheters are firm, but pliable, never rigid, from the proximal to the distal extremity; rigid web-catheters are dangerous instruments, liable to fracture or to cause false routes in the deeper regions of the urethra. The form of the vesical end of catheters must be in accord with its intended uses; straight web-catheters are not so safely or easily introduced into the bladder as the curved, el-

*Early in 1899 were revived the translucent catheters which, about fifteen years before, had but a short vogue on account of their easily stripped thick coating of collodium. The new varnish, used in a comparatively thin layer, is far superior and promises much better results. Another elastic varnish, the "pegamoid," of secret composition, has been suggested for coating catheters.

†It was Sir Edward Horne who first suggested that the tissue of web-catheters be braided upon a curved stylet, in order to obtain an instrument which will always maintain its incurvation.

bowed, or double-elbowed. The tensile strength of the different qualities of web-catheters was ascertained by experiment to be as follows: That of an English "commercial" catheter was forty-two pounds; that of an American "commercial" catheter was fifty-four pounds; that of an American Lisle-thread catheter was fifty-six pounds; that of an American silken-linen catheter was sixty pounds; and that of an English silk-web catheter was eighty-five pounds. An American silk-web catheter of best quality was then tested to one hundred and fifteen pounds without breaking, but the varnish was stripped off at each end. The French manufacturers have since produced very much better qualities of catheters than those formerly in use. The new catheters are soft and pliable, their varnish seldom cracks and resists boiling as well as dry heat. Among them is a flat-elbowed catheter devised by Bartrina for special purposes.

17. When it is necessary to retain a catheter in the urethra and bladder, the physician should select one which is not too thickly coated with varnish. The highest grade of catheter is not always the best for this purpose, because in the course of twenty-four hours the urine filters through the internal wall of the catheter, the silk webbing is thereby saturated, swells irregularly, and uplifts the coating of varnish which soon scales off; whilst the Lisle-thread, silken-linen, and those silk-web catheters with thin external coating, resist longer the action of urine and do not lose their smoothness after being retained forty-eight hours in the bladder. However, if the interior of all web-catheters were thoroughly varnished, and thus rendered impermeable to moisture,

there would be no irregular uplifting of the surface and no scaling.

18. The American "commercial" catheters have lately been much improved in several particulars; they are smooth, soft, and pliable, and may be found very useful in hospital as well as in private practice. Their cost is little compared to that of the higher grades. A catheter of this kind may be used for a single day and thrown away, or may be repeatedly boiled without serious injury and used as long as the surface retains its smoothness. These improved instruments are known as "ten-cent catheters."

19. No catheter whose surface is fissured or otherwise roughened should be passed into the urethra, because it would not only irritate the urethra but perhaps convey therein septic germs. Therefore, for general use it is best and most economic to be supplied with the highest grade of silk-web catheters since, with proper care, they retain their smoothness and suppleness so much longer than the lower grades of instruments. After having used an American silk-web catheter three hundred times, its surface was found as smooth as in the beginning. It was then retired from active service to be preserved as an illustration of the excellence of home manufacture. Another similar catheter, of American make, was used twelve hundred times by a patient, and was set aside only because its surface had become irregular, although it was not cracked.

20. Web and rubber catheters are much injured by fats of all kinds, by glycerin, by saliva, and by vaseline which, however, seems to be the least hurtful of these lubricants. If used at all, it should be in the smallest

quantity—just enough to thinly coat the catheter. Some physicians reject not only the fatty but all other lubricants, and think it sufficient to moisten the catheter with warm water. More soft catheters are destroyed by the excessive use of fatty substances than by any of the many other abuses to which they are subjected. Therefore there is need of a lubricant which shall not be irritating to the urethra, and which shall contain no fat and no free alkali to deteriorate the varnish of web-catheters and soften those of India rubber. After examining different substances it was thought that a watery solution of white soap, deprived of its glycerin and free alkali, with the introduction of tincture of quillaja, to add lubricity to its viscidity, would be likely to answer the purpose. Although its early trials gave some satisfaction, the formula was modified some years after its publication in 1893. The second formula, published in 1899, is as follows:

White Castile soap, powdered	30 grammes
Water	90 f. grammes
Mucilage of chondrus crispus	90 f. grammes
Formalin (forty per cent.)	50 f. centigrammes
Thymol	25 f. centigrammes
Oil of thyme	25 f. centigrammes
Alcohol	75 f. centigrammes

21. The mode of preparation of this mixture is as follows: Heat the soap and water and stir until a homogeneous slime is formed, then add the ninety grammes of mucilage made of the strength of thirty grammes of chondrus crispus to five hundred grammes of water. When cool, pour in the formalin, then the thymol and oil of thyme mixed with the alcohol; stir, strain, and

keep in a covered vessel until all air bubbles have vanished. The result is an opalescent slimy substance, of the consistence of honey, which should be put up at once in sixty gramme collapsible tubes duly sterilised. The chondrus crispus is substituted for the quillaja of the original formula because of the objectionable quantity of alcohol in the tincture, and because quillaja decoction, which was tried, imparts to the mixture a dirty pinkish tint, whereas the chondrus crispus mucilage is colorless. The *Cetraria Islandica* was tested repeatedly and found unsuitable. This saponic lubricant, in its present form, is sufficiently viscid, adheres well to the surface of all instruments, does not lump, and is not unduly irritating to the mucous membranes of the urinary passages. The same quantity of chloral hydrate, or half the quantity of chloroform may be used instead of the formalin, since it is intended solely as a preservative of the mucilage.

22. All web-catheters should be kept at full length, and never coiled, otherwise the varnish will surely soon crack.

23. Web-catheters should be loosely wrapped in dry, antiseptic gauze and preserved in tightly closed metal cases until wanted for use.

24. Before using a web-catheter, it should be sterilised in formaldehyde vapor and be momentarily immersed in a warm, antiseptic solution to prevent cracking of the varnish, particularly during cold weather.

25. After using a web-catheter, it should be well washed by forcing a stream of pure water through the instrument which should then be dipped into the antiseptic solution, thoroughly dried, wrapped in antiseptic

gauze, and put back into its metal case. Catheters should never be carried in their pockets by patients.

26. All web-catheters are liable to harden, lose their suppleness, and be unfit for use in the course of a few years, especially when they have not been in frequent use. On the first appearance of the hardening process, the instruments should be cast aside.

27. India-rubber catheters should be kept at full length, never coiled, and should be wrapped in moist, antiseptic gauze and preserved in tightly stoppered glass tubes, because exposure to the air leads to rapid oxidation which causes the instruments to become hard and brittle.

28. Before using a rubber catheter, it should be sterilised in formaldehyde vapor and momentarily dipped into a warm, antiseptic solution.

29. Rubber catheters become brittle in about two years, and sooner if unused and exposed to the air. But when daily lubricated with fats they seldom last more than three or four weeks, then swell, lengthen, and become so soft as to be liable to be torn across during their withdrawal from the bladder. Several centimeters of such deteriorated rubber thus often remain in the bladder.

30. India-rubber or caoutchouc catheters, known more than forty years ago, were little employed until the year 1873. The first were of pure caoutchouc and so flaccid that they easily collapsed. On this account, vulcanisation of the substance was resorted to in order to increase its firmness, but even then the catheters so made gained little favor on account of their unpolished surface, their clumsiness, and their unnecessarily thick walls which reduced the bore to a minimum. Sundry im-

provements in their construction were afterward made, and the first notice in this country of the improved catheters was given in 1873 by the late Dr. John D. Jackson, of Kentucky. The highly polished soft vulcanised caoutchouc instruments brought from France by Dr. Jackson were styled Nélaton catheters and were made in Paris by Jaques. Although they were improved in New York and Boston, attention was directed to certain defects in the improved catheters: for instance, the ample lumen was at the expense of the walls which were so thin as to make the instruments too flimsy for easy introduction into the urethra and bladder; the broad, oblong eye,* with sharp edges, was two centimeters from the point, so that, during introduction, the instrument doubled up on itself at the middle of the eye. On these accounts a catheter, with countersunk eye and blunt edges not more than six millimeters from the point, was produced under the name of the "velvet-eyed" catheter, which has replaced the other rubber instruments. When the vulcanised rubber used in the fabrication of catheters contains an excess of vulcanising material, it very soon hardens and becomes brittle, hence the frequent fracture of these instruments in the urethra and bladder; and when the materials are insufficient the catheters swell and lengthen after being used for a short time.

31. *Bougie, candela, candelula, candeletta, virga cerea;* are the names by which a cylindric instrument for stricture dilatation has long been known among Latin nations. The term bougie is one of the many examples

*Multiple eyes in catheters of all kinds have long since been discarded for well-known reasons. Even two-eyed catheters are now among the curiosities of the surgical arsenal.

of the perversion of words and of the arbitrary meaning given to them. Thus Bijiyah, Bougeiah, Bugia, Bougie. are among the modern varieties of the name substituted for that of the Roman colony of Saldaa. The Roman town was built upon the declivity of a mountain at the mouth of the Aduse River one hundred and twenty-two miles east of Algiers. The present town lies upon the ruins of the ancient settlement which was invaded by the Vandals in the fifth century but which, from the year 708, was under the domination of Arab conquerors, and then followed the fortunes of divers Berber dynasties, owing its name Bijiyah to the Berber tribe of Bedjaia (1068); En-Nacer, the founder of the new town, having tried in vain to give it his name. The place was named Bugia,* probably by the Spanish who took it in 1509 and retained possession until 1555. It afterward passed into the dominion of the Dey of Algiers and, in 1833, was occupied by the French who called it Bougie. For many centuries it had been a thriving seaport, at one time a safe harbor for Algerine pirates (hence its invasion by the Spaniards) and a trading station for metals, oils, and wax, brought from the interior by the Kabyles. The wax and candles of the town of Bougie were much valued in the markets of southern Europe,† particularly in those of France. The populace and traders, ever prone to abbreviate regardless of propriety, substituted

*The writer's attention was directed, by a client, to the Italian word *bugia*, which means a lie, with the suggestion that it might be allied to the medical term, but he has since ascertained that *bugia*, lie, has nothing whatever to do with the town of Bugia, but is related to the Provençal *bauza*, deceit, the verb being *bauzar;* to the old French *boiser*, to cheat, *boise*, fraud, and this to the old German *bōsa*, badness, roguery.

†The Venetians, who were the first to make known wax candles in Europe, had learned their use from the Arabs.

for Bougie-wax candles, wax bougies, then suppressing the wax and naming all kinds of candles bougies, and finally giving the name of bougies to all cylindric urethral instruments, whether of wax or of other substances. The word has been so long used in medical language that it would now be unwise to substitute any new name for bougie, inexpressive as it is of the uses for which it is intended. This term bougie will continue to be employed to signify an instrument for exploring or for dilating some of the excretory ducts of the body until the right term is coined by properly constituted authority.

32. The time of the invention of instruments now styled urethral bougies can scarcely be fixed with certainty. The following are the only sources of information which have been accessible to the writer: Andrea Lacuna (1551), a Spanish physician, thought that bougies were invented by Philippe, an itinerant Portugese charlatan, who communicated to him his mode of producing them. They were made of wax, with a central longitudinal wick, and were then introduced as far as the bladder for the diagnosis and treatment of "caruncles or carnosities." The point in the bougie where a "caruncle" or a "carnosity" was supposed to have left an impression was further excavated or the caliber of the bougie, at that spot, was lessened by pressure or by rotation between two hard bodies, and this space filled with an unguent in which entered acetate of copper, yellow sulphide of mercury, vitriol, alum, vinegar, litharge, etc. The bougie, thus prepared, was introduced into the urethra so that the medicated part acted upon the "caruncle." Amatus Lusitanus (1554), a Portugese physician, said it was he who, during

his stay at Lisbon, had taught Philippe the manufacture and use of these bougies and that he, Amatus, was indebted to Professor Aldereto, a physician of Salamanca, for his knowledge of the bougies. Alfonso Ferri, of Naples, asserted, in a work printed in 1553, that he had used the unguent and bougies as early as 1548. However, this unguent and its uses were described in the sixth century by Alexander of Tralles. Ferri had used, for urethral exploration, stems of malva, parsley, and fennel; also leaden cylinders which he sometimes passed as far as the bladder. By other physicians, these leaden cylinders were rubbed with mercury, which rendered them so brittle that the process was soon abandoned. Petronius, Paré, and many other physicians of the time, made use of the unguent, more or less modified in its component elements, and of the several bougies, medicating them with the object of destroying the supposititious "caruncles and carnosities." Giannatus, an Italian charlatan, treated Charles IX for pretended urethral "carnosities"; employing bougies medicated with an "escharotic ointment." In speaking of "tin bougies," Jourdan said that they were generally cylindric, but that Francisco Diaz suggested for them a pointed triangular form in order that they might more easily pass beyond the "carnosities." Here then is an early link in the evolution of conical bougies. Soon after the time of Diaz whalebone bougies were used, but as soon given up. Daran* revived in France the

*In an assembly of ladies and gentlemen, casual mention was made of Daran, whose name was constantly before the people, for he did not hide his light under a bushel. One of the ladies, hearing it, asked, "*Quel est donc ce monsieur Daran?*" A wit quickly replied, "*C'est un homme qui prend nos vessies pour des lanternes.*"

use of medicated bougies and published many "cures," but some of his contemporaries, better instructed, soon showed that his good results were due to the mechanical dilatation effected by the bougies rather than to any medicinal action of the substances which entered into their composition.* It was not until the time of Thedn and Bernard, in the eighteenth century, that elastic bougies were made for the purpose of dilating urethral strictures, and these bougies have ever since been undergoing improvements in construction and form from the hollow cylinder to the solid, from the straight to the elbowed, and from the conical to the olive-tipped.

33. Whalebone bougies were used in France and in America early in the nineteenth century. Doctor Horatio G. Jameson, of Baltimore, spoke well of the utility of such bougies, "the size of a small knitting needle," in the treatment of urethral strictures.† Whalebone bougies as now used are of two kinds: those with olivary point and elbowed, about one millimeter in diameter, to serve as conductors for tunnelled sounds; and those for dilatation of very narrow strictures, also elbowed and olive-pointed, are not over one millimeter for the first five or six centimeters, thence increasing gradually in diameter so that at nine or ten centimeters they are equal respectively to No. 2, 3, 4, 5, 6, and 7 of the English scale; the set comprising six bougies. All whalebone bougies require to be thinly coated with carbolised petrolatum and preserved in metal tubes,

**Observations chirurgicales sur les maladies de l'urèthre traitrées suivant une nouvelle methode. Par Jacques Daran. Nouvelle édition*, 1748.

†Medical Recorder, 1827.

otherwise they become dry and brittle and are soon destroyed by parasites.

34. It does not seem necessary to do more than to make bare mention, in this note, of some of the many kinds of bougies used from the time of Bernard—as those, made of catgut, recommended by Dr. Dease, of Dublin, in the eighteenth century; those of gentian root, of slippery-elm bark, or of prepared sponge (Aliqué); of the œdalic bougies of Lioult (1828); of the air dilators of Ducamp and of Arnott; of the elbowed bougies of Benjamin Bell (1793), and of Whateley (1806); of Ducamp's wax-tipped bougies for taking impressions of strictures, and of Bigelow's gutta-percha bougies for the same purpose; of Civiale's wax bougies; of Sir Charles Bell's "ball probes" for the exploration of urethral strictures; of Leroy d'Etiolles' soft *bougies-à-boule;* of Olioli's urethral stenosiometer; and of the metallic bulbous bougies of Otis.

35. Sounds are of two sorts; one for sounding the bladder for stone, the other for dilating urethral strictures.

36. The sounds for bladder exploration are solid steel cylinders or hollow silver or German silver cylinders, all sometimes styled stone searchers. The first named are of short curve, nearly rectangular, as well represented in Mercier's rectangular sound which he used to explore the prostate. The second and third, almost as rectangular as the first, are represented by Mercier's stone searcher with laterally flattened broad extremity, by Langlebert's lithophone with the eye on the concavity of the bend, and by Thompson's searcher whose eye is at the point of the instrument's elbow. Each is provided with a cylindric handle; the whole

length of the searcher being about thirty-five centimeters.

37. The sounds for stricture dilatation are ordinarily of smoothly polished steel; a few have lately been made of aluminum bronze. These metallic sounds are not regarded with favor by some surgeons who, for dilating strictured urethræ, prefer to use flexible web-bougies. However, the majority, at least in this country, employ the steel sound after dilatation has been effected by soft bougies up to No. 7 or 8 of the English scale. The set of steel sounds used by the writer consists of twelve numbers, from 5 to 10.5 millimeters in diameter, corresponding to No. 7 to No. 18 of the English scale. Any urethral sound or catheter may be perforated longitudinally at its vesical extremity for use with a conductor, but a special instrument known as the tunnelled sound was devised by the writer for the dilatation and divulsion of narrow strictures, especially those complicated with false routes.

38. Curvatures of different degrees have been given to metallic catheters and sounds from the Celsian to the present time. Although both Franco and Paré had realised the importance of curving rigid catheters conformably to the natural incurvation of the urethra, their excellent precept that to sound with facility and little pain, the bend of the instrument should be as nearly as possible equal to the curve of the urethra, was not enforced until more than a century later, when Jean Louis Petit gave it the sanction which his great authority conferred in questions relating to surgery. The sigmoid catheter which he devised for the purpose of easy sounding, was similar in form to that unearthed at Pompeii

since his time. But there still remained something more to be done toward reaching precision in the curvature of catheters and sounds, and this was finally accomplished in France and England. Heurteloup, impressed with the teachings of his eminent predecessors, contrived a sound with a curve equal to one fourth the circumference of a circle eight centimeters in diameter. Some years afterward, the late Sir Henry Thompson, assisted by Mr. Briggs in making measurements of the urethra on the cadaver, found its curve to average three tenths the circumference of a circle of the diameter of "three inches and a quarter," the axis of the circle corresponding to the center of the pubic symphisis, and adapted the curve of his sounds to this average. The Heurteloup and Thompson curves are those which seem to answer the present purposes.

39. Besides the correction of their curve, sounds which are given a moderate conicity, making them practically cylindric wedges, are introduced more easily and cause less pain than the old blunt instruments. The principle is an old one, and though recommended by Liston and other masters, it does not seem to have been much applied, neither does it appear that any methodical or definite conicity was adopted for sounds before 1864, when the writer devised a set of steel sounds whose point in each is not more than four numbers smaller than the shaft; the conicity occupying four centimeters. The length of each instrument, from the point to the junction of the shaft and handle, is twenty-three centimeters. The handle, 6.5 centimeters in length, 2.5 at its broadest part, is flat and smooth, and its edges have no angular projections.

II

CATHETERISM AND ITS ACCIDENTS

1. Before taking into consideration the subject of catheterism and its accidents, and also of the nature and treatment of disorders of the urinary organs, it will be proper to define the technical terms used to designate those regions of the urethra to be traversed by instruments employed for its exploration and for the treatment of its affections. To subserve these practical purposes the urethral canal, which averages twenty-one centimeters in length from its external to its internal orifice, may be arbitrarily divided into six regions, as follows: the balanic region, which begins at the external meatus and ends at the base of the glans penis; the phallic region, which begins at the base of the glans penis and ends at the peno-scrotal junction of the urethra which is one of its specially vulnerable points, by instruments incautiously used; the scrotal region, which is that part of the canal seated between the peno-scrotal and the perineo-scrotal junctions; the perineal region, which occupies the space between the perineo-scrotal junction and the bulbo-membranous junction which is the most vulnerable point of the canal during careless and violent catheterism; the membranous region, which is included between the two layers of the triangular ligament; beginning behind the urethral bulb and ending at the apex of the prostate; and the prostatic region,

which is the part of the urethra that traverses the prostate longitudinally, beginning at its apex and ending at the vesical orifice.

2. These annotations are intended as hints to physicians who have not yet become expert in the art of urethral catheterism,* and as warnings to auto-catheterists who have not acquired the skill and experience needed to cope with difficulties such as are very often encountered in the use of bougies, sounds, and catheters. In ordinary circumstances, few manipulations seem simpler and easier than the passage even of a rigid catheter to relieve a distended bladder. But let a wrong direction be given to the instrument's point, or be there some other obstacle to its progress bladderward, such as a stricture or an enlarged prostate, the catheterist's tribulations begin. He is baffled, he loses self-control, his hand and mind wander, and he is oblivious of the relative anatomy of the urinary conduit and of the character of its texture which, unfortunately for the patient, a high authority had advised the catheterist to "forget!" Before recovering from his mental confusion he makes a desperate, violent onward push that sends the point of the catheter, perhaps three or four centimeters into the ambient tissues, to the great distress of the sufferer who, seeing blood issue instead of urine, frantically clamors for relief or pitifully groans from the pain inflicted. This picture is but a faint outline of what often occurs from unskilful catheterism. Urethral laceration, false routes, and other accidents are generally

*The inexact term *catherization* is too often used by writers and teachers instead of catheterism, derived from the Greek *katheterismos*, a putting in, which is Latinised into *catheterismus*', Gallicised into *cathétérisme*, and Anglicised into *catheterism*.

averted by observing the rules given, by the masters from the Celsian age to our time, for the performance of this delicate operation.

3. The term catheterism is used not only to convey the idea of putting in a hollow tool for the relief of a bladder full of urine, but for the introduction of instruments designed to explore or to irrigate the urethra and bladder, to crush vesical stones, to dilate the strictured urethra or to remove foreign bodies.

4. A mastery of the principles and practice of catheterism is essential to success in the treatment of affections of the urethra, prostate, and bladder. The beginner soon realises that such mastery is attainable only after a thorough knowledge has been gained of the special and relative anatomy of the parts and of the nature, properties, and mechanism of the needed implements; and is to be acquired through frequent trial of the various instruments, upon the cadaver, before venturing to employ them for the relief of sufferers. When he happens to examine records of cases, he finds that many of the ill results of urethrotomy, cystotomy, and lithotrity had been due to clumsily performed catheterism, causing false routes and so marring or even defeating the operation. It is then that he begins to appreciate the importance of early practising simple catheterism, with the steel sound, upon the dead.

5. Of the divers sorts of urethral and urethro-vesical catheterism, only the exploring, dilating, evacuating, and irrigating need now to be examined. The importance of the subject warrants the repetition that catheterism demands the utmost deliberation and gentleness, the greatest steadiness and lightness of digits, the

clearest conception of the anatomy of the parts, and the most precise concert of action of mind, eye, and hand. The honeyed utterance of Civiale—*doucement et lentement*, gently and slowly—in the performance of catheterism, whenever borne in mind, has often served to prevent serious injury, which rough manipulation and precipitate action so frequently inflict upon the urethral canal. Catheterism for urethral or urethro-vesical exploration, as well as for dilatation and evacuation, is ordinarily performed during dorsal decubitus of the patient, because the standing posture favors syncope, and because recumbency of the patient is much more convenient to the operator, seated as he is by the sufferer's left side for urethral, and by his right for vesical exploration.

6. Urethral exploration for the detection of a foreign body or of a suspected calculus impacted in the canal, is made with a metallic instrument which serves at the same time for the extraction of ether; the most commonly used being the slender alligator-jawed forceps, and the urethral lithotrite (of which there are several kinds) in the case of a calculus too large to be removed in its entirety. For oblong foreign bodies in the bladder the explorer should also be the extractor. Ordinary lithotrites generally answer the purpose of searching for and removing pieces of soft catheters from the bladder, whilst special tools are employed in the extraction of parts of metallic catheters and other hard, oblong, or cylindrical objects.

7. Urethral exploration of the prostate is made with the cysto-pylometer or with Mercier's rectangular solid sound which does well also for explorations of the bladder

walls; whilst the detection of stone may be achieved with Mercier's hollow rectangular instrument whose beak is broad and flattened laterally, or with Langlebert's or Thompson's searcher.

8. Urethral exploration of stricture is best made with the soft, flexible, acorn-tipped web-bougie, the penis being held between the middle and ring fingers of the left hand, palm up, while the thumb and index retract the prepuce and part the lips of the meatus. A previously lubricated bougie, whose acorn-shaped tip is as large as the urethral orifice will admit without being overstretched, is then slowly inserted and gently pushed onward until it reaches an impediment. The length of the bougie being known, measurement of the distal or extra-urethral part from the meatus will give approximately the situation of the stricture. For practical purposes it is essential only to know if the stricture be in the phallic, scrotal or perineal region of the urethra. A smaller bougie, which just passes the strictured point, indicates its caliber and, leaving it in that position for a few seconds and slowly withdrawing it until the base of the acorn reaches the vesical end of the obstruction, the length of the stricture is easily ascertained by proper mensuration of that part of the shaft of the instrument which is out of the canal. A second or a third stricture may be diagnosticated by this same, or if need be, by smaller acorn-tipped bougies. Metallic bulbous bougies cannot be used with the same delicacy and precision as the soft instruments, and their rigidity is often a source of danger.

9. Dilating catheterism, whose purpose is the restoration of the urethra's normal caliber, is ordinarily effected,

in the case of narrow strictures, free from complications, by the momentary insertion of flexible web-bougies every second or third day, increasing the sizes until No. 7 or 8, of the English scale, shall have been reached. After this, conical steel sounds may be used every four or five days, and seldom exceeding No. 15, English scale. Those patients who live far away from the reach of their surgeon should not be intrusted to pass steel sounds, as they are not likely to acquire the needed skill, and are almost certain to do serious mischief to their urethræ. They should therefore be taught the use of soft, olive-tipped web-bougies not larger than No. 13 in the shaft.

10. To refrain from making a false route or otherwise injuring the parts during the passage of a metallic instrument in the urethra, the incurvations of the canal should be kept constantly in mind; the first point of danger being at the peno-scrotal, and the second at the bulbo-membranous junction. To guard against these disastrous accidents, the operator should direct the extremity of the sound downward toward the perinæum, after the manner of the ancient *tour du maître*, so as to prevent inpingement at the first-named point of danger. Having passed this point, he makes, with the handle of the sound, a slow and deliberate sweep upward and to the patient's left, which brings its extremity in the proper position; then very slowly depressing the handle between the patient's thighs at the same moment that the end of the sound is tilted up as it arrives at the second point of danger, namely the bulbo-membranous junction, it slips easily into the bladder.

11. The catheterism of narrow, eccentric, tortuous urethral strictures, especially those complicated by false

routes and distressing retention of urine, is one of the most delicate, difficult, and often perplexing of surgical procedures requiring, for its safe and successful execution, mature experience, skill of the highest order, slow and gentle manipulation, imperturbable coolness, exhaustless patience, and unrelaxing persistence. The first step in this kind of catheterism is to lubricate the urethra by filling it with warm olive oil or with petrolatum; the next is to pass an elbowed capillary whalebone bougie with which to explore the region of the stricture until its lumen is found, when the bougie will enter the narrowed canal. But even after the bougie has passed the strictured part, its extremity is liable to glide into the mouth of an enlarged lacuna or of one of the ejaculatory ducts, from which it must be disengaged, slightly rotated, and slowly pushed onward, when at length it reaches the bladder. This process sometimes occupies half an hour or even a longer time. Dilatation may then be made with a small conical tunnelled steel sound; the whalebone bougie being the conductor for the sound. The success of these steps generally ensures the good effects of the subsequent dilating catheterism and is almost always prophylactic of cutting operations. When it happens that dilatation can not be carried beyond No. 2 or 3, then a web-catheter No. 2 or 3 is introduced and retained twenty-four or forty-eight hours, during which time the urine constantly trickles away, to the relief of the bladder, and this "continuous dilatation" facilitates the passage of larger bougies, so that in a few days dilating catheterism in higher numbers is performed with comparative ease.

12. The foregoing is assuredly the most optimistic

view of catheterism in difficult cases. How often this catheterism is unsuccessful and disappointing, particularly when a false route is to be eluded, those who have had much experience will testify. The operators who "always succeed" are to be congratulated for their *invariable* success! When, after repeated patient trials by an expert, the bladder can not be reached by the bougie, the only resort is external perineal division of the urethra after capillary hypogastric puncture of the bladder and aspiration of the urine to afford temporary relief in case of great urgency.

13. Unduly frequent and excessive dilating catheterism is undesirable, injudicious, irrational, and harmful. The consequent bruising of the mucous membrane excites a sub-acute urethritis whose exudate in the underlying connective tissue undergoes sclerous degeneration, ending in loss of suppleness and permanent contracture of the whole canal.

14. Evacuating catheterism is used to rid the bladder of calculous detritus after lithotripsy; to aspirate clots of blood or slimy urine from the bladder; to relieve retention of urine due to urethral stricture or to prostatic obstruction; and to draw off urine daily in cases of its stagnation from urethral or urethro-vesical impediment.

15. For aspiration of calculous detritus after lithotripsy and of blood clots from profuse cysthæmorrhagia, as well as excessively thick, purulent, slimy urine, the large metallic catheters adapted to Bigelow's apparatus answer well the purpose. In their introduction, the same care and deliberation should be observed as in the passage of other metallic instruments.

16. In urethro-vesical catheterism for retention of

urine due to a stricture, it is generally necessary to begin by dilating the stricture rapidly, even to the extent of its divulsion, until a No. 4 or 5 tunnelled sound, with the aid of its whalebone conductor, can be introduced; then to substitute a tunnelled metallic catheter of the same size. When, however, it is possible to carry dilatation to higher numbers, as 9 or 10, then a No. 8 web-catheter is inserted and some of the urine allowed to escape slowly.

17. Under no circumstances whatsoever should an over-distended bladder be emptied precipitately; partly on account of the too sudden removal of the hydraulic pressure upon the kidney structure and partly on account of the liability of profuse bladder hæmorrhage. The same precautions should be taken in case of retention of urine from prostatic obstruction.

18. Physicians have often asked—What is the best catheter for use in cases of prostatic obstruction to urination? The invariable answer has been that any one catheter can not well suit all cases; therefore the operator should have a good supply of different forms of catheters adapted to the divers forms of prostatic enlargement. For example, in cases of simple urethro-vesical bars the curved silk-web catheter or the soft India-rubber catheter is sufficient. But in cases of intra-urethral growths, of unilateral projection, of unequal enlargement of both lobes, and of great supra-montanal development, Mercier's elbowed catheter is required, and sometimes the crutched catheter; whilst in cases of much increase of the superior isthmus causing great depression of the prostatic sinus, Mercier's double-elbowed catheter is the most useful.

19. Anent the size of catheters, the commonly asked question is—Should they be small or large? The answer is that they should be neither small nor large, but adapted to the particular urethra to be catheterised. A catheter of full size for a urethra which is under the average in caliber is entirely too small for a urethra of very large caliber. A No. 14 (English) would be small for the large calibered urethra, and entirely too large for a small calibered urethra to which a No. 7 would be more suitable. These, however, are extreme cases. The most convenient size for easy introduction by physician or patient, one that strikes a fair average, is No. 9 (English) equal in diameter to six millimeters. It is rare to find urethræ that do not easily admit instruments of this size, particularly in cases of stagnation of urine from prostatic obstruction. Many patients who are obliged to catheterise themselves labor under the delusion that small catheters are safest and give less pain. To the use of small catheters—especially the rigid—may be ascribed the majority of prostatic false-routes and the frequent attacks of urethritis and orchitis from which auto-catheterists suffer. The best sized and safest for each individual is the catheter that moderately fills without stretching the urethra. Such an instrument gives less pain than the too small or the too large catheter.

20. The India-rubber catheter with countersunk eye is ordinarily the safest in the hands of the inexperienced and of auto-catheterists, in cases to which it is adapted; but even in these cases, it is not safe to continue to use one instrument until it is in a state bordering decay, for it is liable then to break and leave a fragment in the bladder. This occurs among patients who, not appre-

ciating the fact that vulcanised India-rubber undergoes damaging changes from the action of urine and the injurious oxidation from the air, or disregarding their physician's injunctions respecting details in the use and care of catheters, come to grief in consequence. Every one knows how often it becomes necessary to extract from the bladder pieces or even entire India-rubber catheters. But, aside from these accidents, the urethra is often greatly irritated by the rubber catheter, not on account of this material itself, but of the carelessness, boldness, and undue frequency of its use, which come partly of its easy introduction. Painstaking, prudent, and intelligent patients, however, soon acquire sufficient skill in the use of the rubber or of any of the other pliable catheters, and learn to keep them in good order, and when to throw away those which begin to show decay.

21. It frequently happens that the physician is called upon to relieve sufferers from retention of urine when ordinary catheterism is impossible by reason of false passages. In such cases, the common practice had been to make a supra-pubic puncture with an ordinary trocar and insert a catheter or a silver tube to be opened as often as necessary for urination, until puncture with a very slender exploring trocar was employed by Dr. G. N. Dox,* of Geneva, N. Y., and later with a capillary trocar as suggested by Dieulafoy, whose method of puncture followed by pneumatic aspiration is surely a valuable surgical acquisition which can not be too highly prized although it has been used with such undue frequency and unpardonable carelessness, by the unwary

*Medical Record, June 1, 1872, p. 220.

as to have caused its general decrial. The consequences of the escape of a few drops of stale urine in the præ-vesical connective tissue during the incautious withdrawal of the hollow needle, have been so disastrous in a number of cases as to deter many physicians from employing this mode of relief except under circumstances of the greatest urgency, so that in cases of retention of urine complicated with false routes, rather than recur to frequent punctures with aspiration, they prefer to employ Mercier's invaginated catheter by which, in the vast majorities of instances, is accomplished the evacuation of the distended bladder.

22. When a patient has long used the catheter for relief of his bladder, and the urethra has suffered from the consequent irritation followed by sub-acute urethritis with spasmodic contracture of the canal, which renders catheterism painful and difficult, it becomes necessary to irrigate this canal at least once each day and to dilate it with steel sounds every three or four days for two or three weeks, when daily evacuating catheterism is again easy and almost painless. This process has to be repeated every three months or thereabout in the majority of cases. An evil which should be avoided is the too frequent use of the evacuating catheter by the patient who, if not cautioned, passes the instrument every hour or two when he happens to suffer much from vesical spasm which is relievable by the oral administration of one milligramme of hyoscyamine thrice daily, but for not more than four days, as this drug is not tolerated longer by the majority of patients, and its use should not be resumed until four or five days thereafter. It is rarely necessary for the well-trained patient to

catheterise himself more than five times in the twenty-four hours in case of prostatic or any other obstruction to spontaneous urination. Another evil consequence of frequent evacuating catheterism, especially when unclean fissured catheters are used, is sub-acute or even acute orchitis. Either of these complications occurs, in some patients, as often as every three or four months, first on one side, then on the other, seldom on both sides at the same time. After several attacks, the orchitis becomes chronic and sometimes small purulent foci are found in the substance of one or both testes. These abscesses generally open spontaneously and are rarely incised, the patients objecting until taught by experience that early incision is wise and proper. After several such attacks of orchitis the spermatic canals are occluded and the genetic function is at an end.

23. For irrigation of the inflamed and for expansion of the contracted bladder, the catheterism should not be effected by rigid or metallic instruments. The best and safest catheters for use in such cases are those that are easily made to enter the bladder without causing undue pain or irritation, as any of the several forms of web-catheters or the India-rubber catheter with lateral countersunk eye or that open only at the well-rounded end. The double-current catheter should be abolished, if only for the reason that it does not accomplish the desired object of allowing enough of the injected material to accumulate for proper irrigation and for even slightly distending the viscus, since the stream enters through one eye of the instrument and immediately passes out of the other, and not more than four square centimeters of the mucous membrane can be affected by the fluid.

It may be objected that the outlet can be closed for a moment to regulate distension; but such closure would surely convert the instrument into a single current catheter. Why not then use the ordinary catheter, which is simpler, less bulky, and not so costly? The double-current catheter, to say the least, is an unnecessary tool. The substance injected is, of course, that which the particular morbid state of the bladder requires. The injector may be the fountain syringe, the pear-shaped India-rubber bag, or the cylindric syringe. Irrigations for cleansing the bladder may be made by the patient with the aid of the fountain syringe, but when needed for gradual dilatation of the contracted bladder these irrigations should be made by the surgeon who will generally find the India-rubber pear the better instrument, for, with it, he can, by pressure with the hand, quickly determine the degree of justifiable dilatation.

24. A few more words seem needed in reference to the use of steel sounds and to the evils of rash catheterism. The present manner of introducing these sounds for urethral dilatation is as follows: The operator, standing or sitting on the patient's left, seizes the body of the penis laterally between the left middle and ring fingers, palm up, and gives the organ a vertical direction; then, with the right hand he holds a warmed and well lubricated sound loosely by the handle with the thumb and index and middle fingers and gently drops the point into the urethral orifice held open by the left thumb and index; the shaft of the instrument lying close to the body in the direction of the inguinal region. The penis and sound are next simultaneously moved; the penis along the shaft of the sound while the sound is carried

onward to the depth of about twelve centimeters in the urethral canal. The sound is then brought from left to right of the patient to the median line and given a perpendicular position, after which it is guided by a single finger until it has reached the center of the pubic arch and, as it were, introduces itself. Lastly the handle is gently depressed between the thighs, when the point soon enters the bladder. If, during the whole of this simple process, the relative anatomy of the parts and the wise watch-words of Civiale—slowly and gently—be kept in mind, and, if the hand obey the mind, there will generally be no untoward effect. The disasters of awkward catheterism almost invariably come of disregard of these sage injunctions. However, some men of eminence have advocated the rapid and forcible passage of the sound or catheter.

25. The forced catheterism of narrow urethral strictures is said to have been employed by John of Vigo, Paré, Desault, Boyer, and Roux, and an attempt was made of its revival, early in the nineteenth century, by Matthias Mayor, of Lausanne,* whose controversy on the subject was anything but creditable to him. His irrational analogies and faulty arguments in defense of the method of treatment of urethral strictures by forced catheterism were temperately, ably, and successfully refuted by Vidal (de Cassis). Fortunately that particular mode of catheterism is now a thing of the past, recorded in sadness when thinking what horror, dread, and disgust it must have inspired to its victims and to those who witnessed it at the heavy hands of its

Sur le cathétérisme simple et forcé, et sur le traitement des rétrécissements de l'urèthre, et des fistules urinaries. Par MATTHIAS MAYOR *Paris*, 1836.

last advocate. It is fervently hoped that it will never rise from the ashes to which it was reduced by the facile pen of the logical Vidal. Another feeling of sadness arises when it comes to mind that force, in catheterism, is still sometimes used, though involuntarily, by those whose hands are heavy; hence the too frequent occurrence of the urethral false routes and of other accidents!

26. The accidents of catheterism now claim special attention. From the passage of instruments for exploration of the urethra or bladder, for drawing off retained urine, or for dilating strictures, more or less serious local accidents may occur and be followed by grave constitutional disturbances, and these, owing to some injury inflicted to the parts during the operation; but even when the greatest care and gentleness are observed in the handling of the bougie, sound or other necessary tools, or in the accomplishment of the simplest operative procedure, the most baneful are sometimes the consequences. The main local accidents are false routes, more or less violent urethritis, cystitis, prostatitis, gonecystitis, and orchitis; whilst the constitutional manifestations are shock to the nervous system, rigors with febrile reaction, and suppression of urine often ending fatally.

27. Of the local accidents, false routes, unfortunately of too common occurrence, are made with rigid small and even with large calibered instruments used violently in the endeavor to dilate narrow strictures; the operator paying no regard to the two most vulnerable points in the urethra—the one at the peno-scrotal, the other at the bulbo-membranous junction—and forcibly thrusting the instrument onward and thus tearing or

puncturing the mucous membrane or even the spongy substance and making artificial channels which vary in length from one to five centimeters. It has often happened that the instrument has perforated the urethra and run its disastrous course backward between the prostate and rectum, entering that intestine or making its way into the peritoneal cavity. False routes have also been traced far into the cavernous substance of the penis. In such cases the consequent hæmorrhage has been very profuse and even fatal. Urethral false routes are often multiple; as many as three, four, five, or six have been seen from the phallic to the membrano-prostatic region. In all such cases catheterism is extremely difficult even in practised hands.

28. Careless, violent, or unduly frequent catheterism, particularly when performed with infected instruments, has caused distressing urethritis and cystitis lasting many months, and has excited acute prostatitis, gonecystitis, and painful orchitis terminating sometimes in suppuration or even in destruction of the organ.

29. Of the constitutional disturbances consequent upon urinary affections or upon explorations or other operations performed on the urethra or bladder, that of shock to the nervous system is not to be minimised, although in the majority of instances it is not great and is of short duration, but occasionally it is so alarming as to demand the closest attention and medication for many hours after its occurrence.

30. The condition commonly styled urinary, urethral, or catheter fever, is worthy of special notation; first, because the younger generations of physicians of this twentieth century might like to know how the subject

was treated during the third quarter of the nineteenth century; and second, because they might be interested in contrasting the conceptions of physicians of the two centuries regarding the nature and management of these constitutional disorders.

31. The views expressed in 1872, on the nature and treatment of urethral fever due to catheterism or to other operations on the urinary organs, are as follows:

32. Urethral fever, also called catheter fever and urinary fever, manifested by rigors with febrile reaction sometimes followed by suppression of urine, and by sapræmia, was then regarded as being "due to shock propagated by the sympathetic nervous system and reacting upon the blood vascular system."

33. It is well known, however, that this fever does occur in diseases of the urinary organs before any instruments whatever have been used. In such cases, except when there is implication of the upper urinary organs, the affection in question is of a mild type and has often been mistaken for paludal fever.

34. On account of its supposed analogy with malarial fever, it was termed intermittent urethral fever; beginning sometimes as a slight rigor or a sensation of horripilation or fornication followed by very little febrile reaction, and sometimes by a violent, fulminating chill suggestive of the most severe form of congestive remittent fever, and ending fatally in a few hours or even in a few minutes. Banks* recorded two such cases, in the Edinburgh Medical Journal, both under treatment at the Liverpool Royal Infirmary. The first was

*On Certain Rapidly Fatal Cases of Urethral Fever after Catheterism. By W. Mitchell Banks, F.R.C.S.E., etc., Edinburgh Medical Journal, June, 1871.

a man between forty and fifty years old, "apparently much broken down in health. . . . There was a false passage in the urethra; the first catheterism failed but the second, though difficult, was successful with No. 6 or 7 catheter. No undue violence was used, and very little pain inflicted. There was no hæmorrhage or anything to indicate a new urethral lesion except the pre-existing false passage, but almost immediately after the entrance of the catheter in the bladder the patient was overcome by a severe rigor, passed into a state of profound syncope and died in a few minutes. No examination of the body could be obtained, but the existence of a fatty heart was suspected." The second was a case of long and narrow stricture of the phallic region, "which had been gradually dilated to No. 4. On the first day a small probe only could be passed and left in position for half an hour. On the third or fourth day Nos. 1 and 2 metallic sounds were tried without success, and a fine, probe-pointed bougie was inserted and retained ten minutes, and two minims of Fleming's tincture of aconite administered. At the next sitting Nos. ½ and 1 were passed through the stricture, and then a fine, catgut bougie, left in for one hour. The stricture was further dilated chiefly by catgut bougies until the fatal day when a No. 4 metallic instrument was easily carried through the stricture and, for the first time, entered the bladder. It was withdrawn in about ten minutes and was followed by a stream of urine but no blood. The customary dose of aconite tincture was given to the patient. In the course of half an hour he vomited his dinner and soon had a chill and another in two hours, and continued to retch. Brandy and

water, with two minims of tincture of aconite was given, but soon rejected, and no drink was afterward tolerated. He complained of pain in the loins and bladder, his pulse became quick and weak, and despite all that was done, he died six hours and a half after the last catheterism. At the post-mortem examination the internal organs were all found to be in a normal state except the kidneys which were slightly congested and from whose calices turbid urine escaped on pressure, but beyond this no renal disease was detected. The bladder contained about half an ounce of thick, muddy urine, and in the phallic region of the urethra, at about five centimeters from the meatus, was a long, narrow stricture. No injury whatsoever had been done to the urethral canal."

35. Cases of a similar nature to those related above are mentioned by Velpeau, Reybard, and other observers, but in the majority of instances death was not so sudden as in Banks' cases, for it generally occurred in from twelve to twenty-four hours or even a longer time after the last catheterism.

36. In long-neglected strictures with renal implication, urethral fever is almost certain, sooner or later to occur after catheterism, even when the wisest precautionary measures are taken. The process of dilatation may have been employed at regular intervals for several weeks or months with good effect or it may have given rise occasionally to a mild febrile reaction, but, at length, however careful may have been the catheterism, it is followed by a fulminating rigor which proves fatal in a very short time. In the third edition of his work on stricture, Sir Henry Thompson gave an inter-

esting account of a case of this kind, but without satisfactorily accounting for the exact pathic condition that could cause such sudden death, and said: "I have seen one case of old-standing and narrow stricture, in which death was thus caused within fifty-four hours of the passing of an instrument, the same that had been habitually employed on at least a hundred occasions before; no damage whatever having been inflicted by it upon the urethra, as verified by several careful observers on close post-mortem examination of the parts. Rigors and vomiting commenced about an hour after the catheterism, and not another ounce of urine was secreted from that time until death. The kidneys were congested to an extraordinary degree, and their substance was so soft and friable as to give way under gentle pressure. Very rapid changes had evidently taken place in these organs, but no signs whatever of inflammation existed in any other part of the urinary apparatus."

37. The much dreaded fulminating urethral fever following catheterism or any of the other operations upon the urethra or bladder is of much rarer occurrence than formerly, owing partly to the practice of aseptic surgery, and partly to the abstention from major operations upon the urethra or bladder when it is known that the kidneys are involved in serious disease and particularly when microbic infection is suspected.

38. There is, however, a mild type of urethral fever ushered in by headache, general discomfort, lumbar pains, and such other symptoms as precede an attack of "the ague"; the chill occurring as late as from twelve to forty-eight hours after a catheterism or some other operation upon the urinary organs. But this form of

urethral fever quickly yields to treatment and leaves no untoward effects.

39. The opinion long entertained that urethral fever is caused by the contact of urine with a raw surface in the canal is not founded on careful clinical observation, for it has been noted, by men of much experience, that the chill generally occurs before urination, before a single drop of urine could have passed out of the bladder except through a catheter. If contact of urine with a raw surface were the chief cause of urethral fever, this fever would always occur after lithotomy and other operations upon the bladder, prostate or urethra. Therefore the theory of urinary toxæmia is scarcely tenable.

40. Oliguria and anuria following the severe types of urethral fever, though frequent, are not always fatal. The writer has observed this condition in a fair number of instances, and has seen cases of alarming oliguria, on the verge of anuria, rally under energetic treatment and recover, and has also had some fortunate results in the treatment of anuria—one desperate case in particular. The patient, between forty and forty-five years of age, had a stricture which required dilatation. On the day after the first catheterism he was found in a somnolent, semi-conscious state. Incidentally it was ascertained that he had not urinated since the night before. A small catheter was introduced, and, no urine flowing, it was evident from this test and from the symptoms that the kidneys had stopped secreting urine. His breath had a foul, urinous odor, his perspiration, though scanty, had the same urinous odor, in fact, no phenomenon of anuria was wanting. This condition lasted five days,

when at last the vigorous treatment employed had its effect and the patient, who made a rapid recovery, was alive twenty years after the attack. It is rare that sufferers survive anuria longer than four days, despite the most judicious medication.

41. The present views regarding urethral fever are the same as those held in the nineteenth century so far as are concerned the general phenomena of the affection, the prognosis, the treatment and the gross, morbid anatomy; not so, however, in respect to the pathogeny. It is clear now that the sudden deaths recorded by Banks were due to microbic infection; both cases having been subjected to repeated catheterisms some time previously, for in one there was a false route and the patient was in bad general condition owing to his long standing stricture; and in the other there was a dense stricture which had required the passage of instruments every fourth day. In both there surely was abundance of time for the colonisation of infective germs. In the case reported by Sir Henry Thompson, the post-mortem appearance of the kidneys, as it would now be interpreted, leaves no doubt that extensive microbic invasion was the cause of the "very rapid changes which had evidently taken place in these organs." The fatal cases referred to by Velpeau, Reybard, and other surgeons of their time, were evidently of ascending microbic pyelonephritis. In one of the writer's late cases of death after external perineal urethrotomy there was interstitial nephritis from infection by the bacillus aerogenes capsulatus. So it may be said that whenever there are grave constitutional effects from catheterism or other operations upon the urethra or bladder, it is almost

certain that the kidneys are the chief foci of the trouble. Either they were vulnerable from previous disease, or had lately become infected. The occurrence of suppression of urine is owing, in some cases of vulnerable kidneys, to the intense congestion caused by fulminating infection, whilst in other cases it is caused by the irritating elimination of the ether used as an anæsthetic agent in the performance of any operation. A striking example of anuria from the elimination of ether was that of a chronic alcoholist suffering from a hip dislocation. He was at once etherised and kept under profound anæsthesia for one hour when, after repeated efforts it was found impossible to reduce the dislocation. Two days after this he was again kept for an hour under ether anæsthesia, but reduction of the displaced bone failed. On the following morning as he had not urinated, a catheter was passed but no urine flowed. He soon became comatose and died in forty-eight hours. The post-mortem examination showed chronic interstitial nephritis with sclerosis and extreme irregular contraction of both organs. The bladder contained no urine. The observation of several other cases of acute nephritis, in already damaged kidneys, superinduced by prolonged etherisation, has since led the writer to discontinue the use of ether as an anæsthetic and to substitute nitrous oxyde in all doubtful cases, especially in elderly men.

42. Whenever practicable, before undertaking a catheterism or other operation on the urinary organs, a preparatory treatment designed as preventive of urethral fever should be instituted and should consist in free catharsis two or three days before the intended operation;

hot hip baths of not more than five minutes' duration; diluent drinks; tincture of chloride of iron in five minim doses thrice daily; and a nightly dose of five grains of quinine. An hour before the operation a ten grain dose of quinine with two minims of Flemming's aconite tincture, so justly praised by Long, should be administered.

43. If after this preparatory treatment urethral fever does occur, it is likely to be of the milder type and to yield promptly to a drink of hot tea and to the continued use of quinine and aconite, otherwise, that is to say, when the rigors are due to infective pyelo-nephritis, although the most active measures be taken, the chances of recovery are little indeed.

44. When urethral fever is complicated with oliguria, it is of the greatest importance to avoid using any medication likely to further lessen the urinary secretion, particularly opiates and stimulating diuretics which, under the circumstances, are almost certain to cause the total suppression of the urine. However, anuria is not always preceded by oliguria, and often occurs immediately after the operation. In either case the prime indication is to establish and maintain a vicarious excretion of the urinary elements through the intestinal mucous membrane and through the cutaneous surface of the body until the kidneys begin to act. The first is accomplished by the free use of hydragogue cathartics, and the second by diaphoresis induced by internal and external medication. Of the internal diaphoretics and diuretics which may be safely given are: very small doses, not over an eighth of a grain, of powdered ipecac every three hours; hot borage tea, and infusion of digi-

talis in teaspoonful doses every two or three hours. Of external diaphoretics the best are hot hop fomentations to the lumbar regions after free dry cupping, and the hot-air bath which so quickly effects profuse diaphoresis, but should not be used more than twice in the twenty-four hours. The sweat should be wiped off with hot towels three or four times in the day and two or three times the skin should be sponged with hot alcohol and water. The excessive perspiration, together with the vigorous means employed to relieve the kidneys, naturally cause more or less general depression of the vital powers demanding a certain amount of artificial stimulation to fortify and steady the over-taxed laboring heart, so a hot toddy of brandy or whiskey should be given twice or thrice daily, and a simple but nourishing liquid dietary enjoined.

45. Let it be borne in mind that, since catheterism is the beginning and end of genito-urinary surgery and is often attended with many difficulties and grave consequences, the greatest patience, care and gentleness need to be observed in the performance of this delicate operation in order to minimise its dangers.*

*Parts of this and of the first chapter are reproduced from an article published in the New York Medical Journal by the author.

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III

CHRONIC URETHRITIS*

1. The nature and treatment of chronic urethritis for a long time greatly perplexed physicians, because the several pathic conditions which give rise to persistent urethral discharges had not been sufficiently well studied, and because the characters and sources of the discharges were not ascertained. These discharges were found to be so refractory to treatment that many empirical means were used with little or no effect. In speaking of this obstinacy of chronic urethral discharges, Ricord said to his disciples: "After having tried everything, try to do nothing"; for experience had taught him that meddlesome treatment only served to aggravate the trouble which he had often observed to subside soon after the cessation of all medication.

2. Although some light was thrown by Gubler on the differential diagnosis of some of the lesions that cause chronic urethral discharges, little attention was paid to the teachings of his excellent essay on the anatomy and phlegmasiæ of the bulbo-urethral glands, which show that when a persistent urethral discharge of a clear and viscid mucoid substance occurs, its source is surely in one or in both glands, but that when this viscid discharge is purulent there is a chronic phlegmasia of the bulbo-

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urethral gland or of both glands. This clearly indicates that all urethral discharges are not necessarily signs of chronic urethritis. An acute urethritis may be cured and leave no other trace than chronic phlegmasia of a bulbo-urethral gland or of its duct. In some cases, instead of a bulbo-urethral adenitis, chronic cryptitis is consecutive to acute urethritis; in these cases the discharge is very little viscid, but has the odor characteristic of the mucous secretion of the urethral crypts. In other cases chronic prostatitis or gonecystitis may be consecutive to the acute urethritis.

3. Mercier, who made a careful examination of the question of chronic urethritis, did much toward disseminating correct views respecting the pathogeny and treatment of this phlegmasia. Next came the labors of Désormeaux who demonstrated, with the aid of the endoscope, true granular urethritis to be the most common cause of persistent purulent urethral discharge. From that time chronic urethritis has been very diligently studied, and other lesions have been discovered which give rise to chronic purulent urethral discharge, and at present the treatment is directed to the cure of these lesions that have been so well specialised.

4. Chronic urethritis, attended with a slight mucopurulent discharge popularly named gleet, morning drop, military drop, etc., may be a termination of any of the acute types of urethritis, may begin as a benign urethritis and not increase in intensity, or may be developed far back in the urethra, be latent to the sufferer, and discovered by the physician only by means of the urethroscope or a microscopic examination of the urine. It should not be confounded with urethral

blennorrhœa—true gleet. The difference between these two pathic conditions is noteworthy from a practical point of view. Chronic urethritis is a phlegmasia of the urethral mucous membrane yielding a muco-purulent discharge, whilst blennorrhœa is the result of an excessive secretion of mucus by the urethral crypts or by the bulbo-urethral glands without the intercurrence of phlegmasic action, though it may sometimes be a sequel of phlegmasia. Frequent sexual erethism without copulation not unfrequently causes a persistent copious blennorrhœa arising from excessive secretion of the urethral crypts and bulbo-urethral glands, the urinary meatus and glans penis being kept constantly moist by these secretions. This is true gleet, unconnected with phlegmasic action.

5. The phenomenon, chronic urethral discharge, unless rightly interpreted, is likely often to lead astray both patient and physician. The inexperienced sometimes look upon chronic urethral discharge as always an indication of stricture or of some other obstruction of the canal. A little reflection is sufficient to throw doubt upon such a view, if only on account of its want of proper qualification; a suitable qualification being to substitute *often* for *always*, and to say that chronic urethral discharge is *often* a sign of stricture, or is sometimes one of the early symptoms of stricture. Such a view would be indisputable. It is well known that a chronic urethral discharge may emanate from phlegmasia of the seminal vesicles, of the prostatic crypts, of the bulbo-urethral glands, or of the urethral follicles, as well as from a circumscribed or a diffuse phlegmasia of the urethral mucous membrane. It may be asked:

How are these several discharges to be distinguished? The answer is as follows:

6. The discharge from the seminal vesicles contains characteristic sympexia and some spermatozoids, as revealed by the microscope. Either distinguishes it from all the other discharges, even though it be mixed with them.

7. The discharge from the prostatic crypts is turbid, milky, and sometimes contains many prostatic sympexia, and is very slightly viscous.

8. The discharge from the bulbo-urethral glands is known by its extreme viscidity; normally it is of crystalline clearness, but becomes opaque when containing pus.

9. The discharge from the urethral follicles is known by its peculiar odor which it imparts to the semen and which is called the seminal odor.

10. The discharge from a veritable chronic granular urethritis is muco-purulent and characterised by the profusion of pus cells which it almost invariably contains.

11. Chronic urethral discharge, whatever may be its cause, is generally a source of much unnecessary anxiety to the patient, who thinks himself the most sorely afflicted of all mortals, and is almost incessantly watching the drop which he believes is forever to reappear. Of course it does reappear as long as he continues to irritate the urethra by "milking the penis" to find this drop when he thinks it is too tardy in showing itself. The morbid mind of the patient sees in that drop a virulent poison with which he is infected and which he is liable to transfer to any woman with whom he may have

sexual relations, and he has a vague notion that this poison may cause almost any disease. A medical friend related a case illustrating the ludicrous degree to which is sometimes carried the idea that a chronic urethral discharge from the man is liable to cause grave disease in the wife. The patient in question had been told repeatedly that his urethral discharge, which was of clear mucus, was not contagious, but he always doubted the correctness of the physician's view. However, he finally married and his wife soon, as he thought, became pregnant, but on or about the fourth month the abdomen was so much more distended than it would be even at full term, that an examination was made which revealed a large multilocular ovarian cyst whose extirpation necessitated an extended median incision. The anxious husband, who had attributed this condition to infection by his urethral discharge, watched the operation with much solicitude, not on account of its gravity but of the fixed idea that he might be the cause of the disease. When he saw the enormous tumor, he said that if it had been a small lump he would have blamed himself, but that then he could not believe it possible for such a little drop to produce a growth of this size in the short space of four months.

12. Nothing is too absurd for the conception of some of the sufferers from chronic urethral discharges. They listen credulously to the ignorant and mendacious dicta of crafty and rapacious charlatans, while they are suspicious of honest physicians, and obstinately discredit rational advice and correct views. Many change their medical adviser as often as they do their erratic notions of the ailment which, owing to their own perversity,

is destined never to be well. The difficulties encountered in the management of such cases are too well known to require special illustration.

13. The ideas to be impressed upon the minds of patients suffering from chronic urethral discharges are: 1, that these affections generally are not contagious; 2, that virulent urethritis is ordinarily cured within a few weeks, but that in some instances several relapses occur, the last of which is almost certain to be followed by a slight but persistent muco-purulent discharge, liable, even after four, five, or six months, to increase so as to simulate an attack of acute urethritis, subsiding, however, in four or five days, to the former few drops; 3, that not only is this chronic urethritis non-transmissible from a man to a woman but, on the contrary, is frequently aggravated by coition, even with a woman whose genitalia are in sound condition and remain so after the coitus; 4, that the oft reiterated assertion that a man who has once had virulent urethritis in his bachelor days, and marries years after the attack of urethritis, transmits the "gonorrhœal virus" to his wife, is without the slightest foundation; 5, that this irrational notion arose from a belief in a "gonorrhœal virus similar to but not identical with the syphilitic virus"; and 6, that the correct view is that "virulent urethritis" is a local microbic affection amenable to the modern means of local treatment which reach and destroy such gonococci as may linger in the deep urethra, so, chronic urethral discharges of one, two, or three years standing do not contain these cocci and therefore are not communicable whenever the primitive affection has been treated in accordance with the microbic theory.

14. The chief causes of the persistency of urethritis are: 1, disregard of hygienic precautions during acute urethritis, or after its apparent cure. Sexual erethism of any kind, in thought or act, improper alimentation, the use, even moderate, of alcoholic or fermented beverages, over exercise, and excesses in general, all aggravate the acute type of the phlegmasia or, after it has begun to decline, cause its recrudescence, and finally the persistence of the stage of decline which constitutes chronic urethritis; 2, inappropriate treatment of the acute types of urethritis—such as the so-called abortive treatment by injections of nitrate of silver in strong solution, or of strong solutions of any sort, by the abuse or the untimely use of balsamics, antiphlogistics, diluents, and baths—is among the prominent factors in the causation of chronic urethritis; 3, vulnerability of the patient—that is to say, an inordinate susceptibility to phlegmasia, owing to the hyperlithuria so common among chronic dyspeptics, or to some other diathetic influence, besides a constitution naturally feeble or impaired by disease or debauch—may be added to the aetical factors of chronic urethritis; 4, continued local irritation of the urethra is another potent factor in the maintenance of urethral phlegmasia. This irritation may arise from frequent coition, from masturbation, from the existence of a stricture, from congenital stenosis of the urinary meatus, from vesical stones, from chronic cystitis, from chronic prostatitis, gonecystitis, hæmorrhoids, anal fissure, etc.; 5, excessive general and local treatment of the acute types of urethritis, both of which have the effect of prolonging the phlegmasic action. The first, by disturbing the digestive function and enfeebling the

patient and lessening his powers of resistance, besides causing grave complications. The large doses of balsamics long continued have a baneful effect upon the digestive apparatus, and often cause distressing cutaneous eruptions, hyperlithuria, and even nephritis. The too free use of alkaline diluents also tends to disturb digestion and otherwise defeat the objects for which these agents may be intended. The second, the untimely or the excessive use of urethral injections, is a prolific cause of the persistence of urethritis and some of its complications and consequences. The too common tendency to treat the urethra as if it were not a part of the human body is owing chiefly to the want of proper interpretation of its morbid phenomena. It is over-distended, divulsed, or cut indiscriminately, simply because there is a discharge, and without attempting to ascertain the nature of this flow. The idea that the discharge is a sure indication of the existence of a stricture is enough to influence the unthinking to over-distend, divulse or incise the urethra. The patient, impressed with the notion that his case is unparalleled and demands extraordinary measures, consents to any proposed mode of treatment, even to the spilling of blood. He is then contented until he discovers that the urethral discharge is not cured by the operation, and that the drop still obstinately obtrudes itself.

15. The alterations of structure of the mucous membrane in chronic urethritis need to be studied during life by means of the acorn-tipped bougie and of the urethroscope, as well as by dissection after death, on account of their variations in character, site, extent, and depth.

16. In some cases the only perceptible lesion is con-

gestion of the mucous membrane. This congestion is generally diffused over a space of five or six centimeters, involving the bulbous, membranous, and prostatic regions. It rarely involves the whole length of the urethra. Sometimes the membrane is congested only in small patches from the balanic region backward to the perineal region.

17. Most frequently, owing to excessive epithelial exfoliation, in the acute types of urethritis, and the consequent prolongation of the stage of decline, another condition is observable, and that is a circumscribed granular state of the mucous membrane, designated as caruncles and carnosities by writers of the sixteenth and seventeenth centuries, and first demonstrated in the living by Désormeaux in 1864. This granular state is in reality an effort of nature at repair. The denudation of the mucous membrane, during acute urethritis, is more complete in some regions of the urethra than in others, notably in the bulbous portion of the canal, and there is a constant emigration of leucocytes, some of which become partly organised, forming the granulations, while the majority of them are cast away as pus. Unless modified by treatment, the granular state continues indefinitely, and beneath the granulations, in the meshes of the mucous membrane, in the sub-mucous connective tissue, and even in the spongy substance, is an exudate which in time becomes incompletely organised, sclerosed, and shriveled, constituting a stricture. The exudate and granulation tissue may be distributed in multiple patches or may encircle the urethra. Such is one of the modes of development of urethral stricture from chronic urethritis, and this development is often the

work of five, ten, twenty, or thirty years. The suppleness of the urethra is impaired wherever there are granulations with an underlying exudate. The acorn-tipped bougie and the urethroscope reveal both conditions.

18. Another way in which urethritis is perpetuated is when a super-acute urethritis has caused sub-mucous inflammation. In such a case the alteration of structure is much more profound and rapid; sclerosis, shriveling, and stricture occurring in a few months and exciting a constant muco-purulent discharge which is liable to increase in thickness and quantity after the slightest imprudence, even to the simulation of acute urethritis.

19. A noteworthy circumstance is the frequent development of a very mild urethritis, with slight muco-purulent discharge, from what is commonly the first stage of the acute types. This form of urethritis has some of the characters of chronic phlegmasia from the first, and is attended by phenomena similar to those of chronic urethritis consequent upon acute urethritis, and is as persistent. In these cases there are the patches of granulations, the sub-mucous exudate perhaps only in a very slight degree, and most of the other lesions found in the chronic urethritis arising from the acute types; and stricture is one of the sequels of this form of chronic urethritis as much as it is of the ordinary chronic type.

20. When unchecked, chronic urethritis causes alterations of structure in the urethral mucous follicles to the extent of destroying them. It is liable also to be propagated to the bulbo-urethral glands, to the prostate, to the vesico-urethral region, to the seminal vesicles, and to the testicles. Long neglected, even the simplest form

of chronic urethritis almost inevitably leads to stricture of the canal or to contracture of the vesical neck.

21. In the diagnosis of chronic urethritis it should be remembered that all urethral discharges do not necessarily indicate urethritis. Thus a clear, glairy discharge emanates from the urethral follicles without phlegmasic action, and likewise an extremely viscid discharge comes from the bulbo-urethral glands. A purulent discharge may come from the vesico-urethral region, from the prostate, or from the seminal vesicles. The true basis of the diagnosis of chronic urethritis rests upon a complete history of the case, upon gross and microscopic inspection of the discharge, and upon the exploration of the canal with the acorn-tipped bougie or with the urethroscope.

22. If a patient, applying for treatment on account of a persistent urethral discharge, confess to one or two antecedent attacks of acute urethritis, it is fair to assume that his present discharge is the sequel of the acute urethritis, even if this attack of acute urethritis occurred a few months or several years before. But while this information is helpful, it is not sufficient to indicate the particular form and site of the existing chronic urethritis. The other aids to diagnosis, consisting in the use of instruments of precision, are essential to accuracy. The first of these aids to be used is the acorn-tipped bougie; a No. 12 (English) being ordinarily of convenient size for the purpose. This instrument is gently and slowly passed into the urethra until the patient has a sensation of tenderness and perhaps even of pain at a particular spot in the canal. The tender point is generally a patch of granulations covered with a layer of pus.

The instrument is then carried onward to about a centimeter beyond the tender spot where there may be neither tenderness nor pain, left in position for a minute and slowly withdrawn. If the base of the acorn is coated with a whitish substance, this should at once be subjected to microscopic examination. If it proves to be pus, the granular nature of the tender spot may be considered as verified. In some cases the granulations bleed freely on the sligthest provocation and the acorn is coated with blood. During introduction and withdrawal of the bougie, a delicate touch can discern a certain lack of suppleness of the urethra, particularly where there are several tender spots close together, or when a granular space with an underlying exudate encircles the urethral mucous membrane. This does well for urethritis anterior to the bulbo-membranous junction. If the examination results negatively, all the anterior part of the urethra may then be washed, and an acorn-tipped bougie carried beyond the bulbo-membranous junction into the prostatic region and withdrawn as before. A coating of pus on the base of the acorn will indicate the site of the granulations and source of the discharge, or, after washing the anterior urethra, the patient is asked to urinate in two separate glass vessels. If the first urine passed contains pus and the second is free from pus, it may be inferred that the pus has come from the membranous or prostatic region; cystitis being excluded. The urethroscope, however, brings to view the granulations, their extent and their exact locality, or reveals simply a congested state of the mucous membrane, diffused or in patches.

23. When a stricture is already formed, there is al-

most always behind this stricture a granular state of the mucous membrane, which yields a more or less abundant purulent discharge. This is perhaps what has led some observers to consider that a urethral discharge is the infallible sign of stricture. In point of fact, the discharge had long preceded the stricture and was one of the phenomena of the pathic state that caused the stricture: namely, granular urethritis with an underlying exudate; the partly dammed urine irritating the mucous membrane immediately behind the stricture and thus perpetuating the discharge. The cure of the stricture is followed by the disappearance of the granulations and of the consequent discharge.

24. To treat chronic urethritis rationally and successfully it is essential to distinguish the several chronic urethral discharges; to ascertain the cause of the phlegmasia and its duration; the kind of treatment to which it may have been subjected; and the physical condition, habits and environment of each individual. In other words, to make a correct diagnosis. The mere gleet of clear urethral mucus requires no local treatment. It is particularly this gleet that is so excessively treated by so many different cruel methods. The more it is meddled with the worse it becomes, and finally the heroic treatment leads to an almost incurable purulent discharge. Wise hygienic management and avoidance of certain factors in the causation of over-secretion of mucus, such as sexual erethism, suffice to restore the urethral glands to their normal state.

25. The management of sufferers from chronic urethritis is attended with many difficulties, partly owing to the moral as well as the physical condition of the pa-

tients, partly owing to those inherent to the affection itself. The treatment of such patients should therefore be moral, general, and local. Nothing will satisfy them except the cessation of the discharge. To bring this about quickly is the chief indication, so far as the view of the patient is concerned, but to the physician the indication is not only to cure the local phlegmasia which causes the discharge, but to prevent the formation of stricture.

26. The character of the moral management has already been hinted at in the beginning of this conference. In addition, it may be said that the physician should strive to gain the absolute confidence and insure the co-operation of his patient, without which all his efforts to accomplish a cure would be of no avail. He should dissuade him from concentrating his thoughts upon and from continuing to magnify his trouble, and, above all, should break his habit of stripping, squeezing, and "milking" the penis to bring to view the too tardy drop, for this alone is sufficient to perpetuate the discharge which might otherwise disappear even without local treatment.

27. The general treatment is directed toward placing the patient in the most favorable hygienic condition, ministering to his physical state, combating hyperlithuria, rendering the urine sterile, striving to remove all other intrinsic causes tending to perpetuate the phlegmasia, and avoiding medicaments which are likely to disturb the digestive function, such as balsamics whose ill effects are so soon felt. An exception may be made in favor of the oil of gaultheira, which often acts as a very efficient steriliser of the urine in chronic as

well as in acute urethritis; nevertheless, this agent should be used with prudence and in doses of not more than twenty centigrammes thrice daily. Two other valuable sterilisers of the urine are salol and urotropin, used in small doses. Alkaline mineral waters should be given only sparingly and for not more than six or eight days.

28. The local treatment varies with the site of the urethritis, the particular alteration of structure, and the complications.

29. In case of simple chronic urethritis in which there are no granulations or sub-mucous exudate, but only congestion of the mucous membrane, diffuse or in patches, particularly when this congestion is limited to the antebulbar region, mild astringent irrigations are indicated. It is wise, however, to keep the patient under close observation for a week or ten days, and during that time to make no local applications whatsoever, for the general treatment may suffice to cure the urethritis. But if then the discharge persists, the urethra, for the first five or six days, should be irrigated once daily with three or four hundred grammes of a one per cent. boric acid solution. Afterward chloride of zinc should be substituted, but this zinc salt solution should not exceed in strength one to one thousand. The quantity of fluid used for each irrigation should be the same as that of the boric acid solution. As a general rule, this form of chronic urethritis yields rapidly to the irrigations and is cured in the course of a few weeks.

30. In case of chronic cryptitis, the antebulbar irrigations of boric acid and afterward of zinc chloride should be made from before backward, so as to wash away from the crypts the accumulated muco-pus.

31. Chronic urethritis, with granulations, demands a somewhat different treatment, although in the beginning the irrigations with boric acid solution should be used for several days. If the granular urethritis be antebulbar, the best modifier that can be used is the nitrate of silver in solution of one to a thousand, one to five hundred, one to three hundred; but seldom increased in strength beyond the last figure. The amount of fluid used should not be less than two hundred grammes for each irrigation. This kind of urethritis, being in reality a stricture in embryo, requires something besides the treatment just prescribed, and that is the use of dilating instruments as preventive of the threatened progressive contraction of the urethral canal. This process of dilatation, with steel sounds, should be continued until the normal suppleness of the canal is restored.

32. In granular urethritis of the membranous and prostatic regions, particularly in case of co-existing chronic gonecystitis, the strength of the silver solution may with advantage be increased to one or even to two per cent.; and ninety to a hundred grammes of the solution should be used every four or five days. The bladder should contain a little urine; enough to insure the quick decomposition of the silver salt, which it does not need. (It is well known that when fluid is thrown slowly and without undue force through a catheter as far as the bulbo-membranous junction, it returns and escapes at the external meatus, but that when the catheter is passed into the membranous region none of the injected fluid escapes externally, but enters the bladder. Mercier called attention to this many years ago, and the

experiences of other physicians have confirmed the view.) Two days after each urethral irrigation a steel sound of moderate size should be cautiously passed as far as the bladder, not oftener; and it should be borne in mind that too frequent catheterism or excessive dilatation only serves to defeat the very objects sought to be attained. The sound should be carefully withdrawn in a minute's time; the purpose of its introduction being to make pressure upon the granulations, to slightly stretch the urethra at the seat of disease, and to restore the suppleness of the canal.

33. There are cases of granular urethritis that obstinately resist this treatment. These cases require direct applications to the granulations, to accomplish which the use of the urethroscope becomes necessary. The granulations thus brought to view are penciled with a solution of silver nitrate, two, three, or even four per cent., every three or four days until they disappear. Sulphate of copper and other substances have been employed for the purpose but are all inferior to the nitrate of silver.

34. In chronic urethritis anterior to the bulbo-membranous junction, strong solutions are not well borne, are even mischievous, and therefore contra-indicated; but are well tolerated and effective when applied to the membranous and prostatic regions, where they may be used with advantage somewhat after the method of Guyon, by the instillation of twenty or thirty drops of silver nitrate solution of four or five per cent. strength, to be, in a minute's time, washed into the bladder by a rapid current of water and so decomposed by the contained urine. The process may be repeated every three

or four days. This mode of treatment having given good results in acute trachoelocystitis, was resorted to with equally good effects in intractable cases of granular urethritis, particularly those complicated with chronic gonecystitis and prostatitis.

35. Counter-irritation is still employed by some physicians in the treatment of certain cases of chronic urethritis involving the perineal or prostatic or both regions of the canal, especially those attended with dull perineal pain and a constant, teasing sensation of irritation in the parts. This counter-irritation is effected by the use of vesicating collodion applied to the perinæum, with a camel's hair brush, on one side of the raphé, over a surface of one by four centimeters. The perinæum is then covered with a layer of absorbent cotton; and when the blistered surface is healed, the process is repeated on the opposite side, and so every few days until the desired effect is obtained.

36. When stenosis of the external urethral orifice or of any other part of the canal is the cause of the persistence of the urethritis, there is no other cure than the prompt removal of this cause, by the incision in the first case, and in the second, by dilatation, divulsion, or incision, according to the site and character of the stricture.

37. In chronic urethritis due to urethral tuberculosis, no treatment other than the palliative is of any avail. The discharge increases from day to day, in it swarm the characteristic tubercle bacilli, and the patient soon succumbs to the inroads of general tuberculosis. A specimen exhibited showed tuberculosis extending from the meatus urinarius to the bulbo-urethral glands, spermatic canals, seminal vesicles, prostate, bladder,

peritonæum, and right ureter and kidney. The left kidney had undergone compensatory enlargement and was not tuberculous. Both testicles had been extirpated, on account of tuberculosis, six months before the patient's death. The specimen was a particularly good illustration of ascending tuberculosis of the urinary apparatus. There had been for several weeks a thick urethral discharge in which great numbers of tubercle bacilli were detected by the microscope. Other specimens were exhibited to illustrate descending tuberculosis of the urinary apparatus; the disease having begun in the lungs, and secondarily affecting the kidneys, descended to the bladder and urethra and caused an obstinate purulent discharge.

IV

BULBO-URETHRAL ADENITIS AND ORCHITIS*

1. Bulbo-urethral adenitis and orchitis having been referred to so often, in the foregoing notes, as consequences of acute and of chronic urethritis, their examination finds place in this particular series of annotations.

2. The following brief statement of the history and anatomy of the bulbo-urethral glands may be of interest and service in the investigation of their morbid states and in their diagnosis and treatment. These glands were discovered by the anatomist and surgeon Méry, who published a short account of their site and nature in the *Journal des Savants* for the month of June, 1664. Another claimant to the discovery was William Cowper, who, unaware of Méry's labors, wrote a note on the afore-named glands which appeared, in 1699, in the *Philosophical Transactions;* and in 1702 published a further description of the glands with excellent copper-plate illustrations. These little bodies have ever since borne the name Cowper's glands. Other anatomists have urged their claims as discoverers of the tiny bodies which they named little prostates, accessory prostates, and antiprostates, although they bear no relation to the prostate in general character

*Abstracted (with additions), from Lectures VII and X in "Diseases of the Urinary Apparatus."

or in the nature of their secretion. Much later they were more thoroughly studied by Gubler, who, in his thesis published in 1849, gave the results of his researches into their anatomy and pathogeny and designated them bulbo-urethral glands because of their very close relation to the bulb of the urethra and because a man's name given to the organ could convey no definite conception of its uses. These little bodies, true examples of racemose glands, lie close to the end of the urethral bulb in the substance of the ischio-urethral muscle underneath the membranous region of the urethra about one millimeter on each side of the median line or often touching each other. They are globular, ovoid, or flattened, and from five to eight millimeters in diameter, and proportionately longer in the fœtus. Protected by a fibrous envelope, they are made up of a gangue of connective tissue in the interstices of which are lodged spheroidal crypts, whose diameter varies from the 1-300 to the 1-150 of a centimeter, clustering about minute tubes which converge and form larger and larger tubes that end in a common excretory duct. The crypts, tubes, and duct are lined with epithelial cells of cubic form. The common excretory duct of each gland enters the urethra near the base of the bulb, lies under the mucous membrane and opens at the side of the median line at the distance of from two to four centimeters from its origin by a very narrow orifice, one generally a few millimeters in advance of the other. This duct varies in caliber from a quarter of a millimeter to one millimeter. Cowper, having found some accessory glandular lobules in front of one of the glands, thought that they constituted an additional gland, and in one of his admirable

copper plates figured a third duct. The existence of two common ducts to one gland is evidently a very rare anomaly, otherwise it would have been reported by the anatomists who wrote on the glands and their uses.

3. The normal bulbo-urethral glands secrete a clear and extremely viscid mucoid fluid which becomes turbid in disease, but still retains its viscidity, which distinguishes it from the secretion of other urethral glands. This mucoid substance may be drawn into thready films from ten to fifteen centimeters long. It froths when rubbed between the fingers; its reaction being alkaline. These glands yield service to the urinary as well as to the genital apparatus. In the first instance their viscid secretion increases the lubrefying qualities of the mucus from the urethral follicles, and in the second instance the viscid secretion is sufficiently abundant, immediately before the sexual act, to freely lubricate the glans penis preparatory to intromission, and to aid the other secretions in properly diluting the semen.

4. Bulbo-urethral adenitis is generally a sequel of acute or chronic urethritis, though it sometimes arises from a slight contusion of the perinæum, and also from injury through its duct by a filiform bougie. It is very rare that both glands are affected at the same time. The writer has seen but one case of this sort; both glands having suppurated and left a small fistulous orifice on each side of the perineal median line. The left is more frequently attacked by disease than the right gland. The affection appears in acute and in chronic form. In the acute form, resolution ordinarily occurs in the course of a few days, and the gland seldom suppurates. The chronic form, which causes one of the several kinds

of chronic urethral discharges, should not be confounded with chronic urethral cryptitis, although they often co-exist, but are easily distinguished; the one from its extreme viscidity and the other from its peculiar odor. Cowper and other observers of the frequent turbid, slimy discharge which seemed to come from these tumefied and indurated glands during or after an acute urethritis, regarded them as the seat of "gonorrhoea"; thus mistaking effect for cause.

5. Acute inflammation of one gland or of both glands due to urethritis is frequently unrecognised owing to the pain and tension, so often felt in the perinæum during the second to the fourth week of acute urethritis, which are ordinarily attributed to the phlegmasia itself or to other causes, and owing to the cessation of pain and tension supposed to have been the effect of the remedies employed to cure the urethritis, whereas in reality the cessation of this pain and tension was due to resolution of the inflammatory process.

6. The chief symptoms, especially in the milder types of inflammation of this gland, are: swelling, tension, and pain in the perineal region, tenderness on pressure, pain from friction of clothing, and a steady burning sensation in the deep urethra. Such cases are not attended with febrile reaction and generally end in resolution within four or five days.

7. The progress of the disease, in some cases, is such that suppuration occurs in the course of eight or ten days; the pus breaking the bounds of the gland, infiltrating the surrounding connective tissue and even extending to the scrotum. In these circumstances the swelling and tension are greatly increased, and the

throbbing pain and febrile reaction are sure indications of suppuration. Without prompt surgical interference, retention of urine is almost certain to follow, and perhaps perforation of the urethra and a consequent urinary fistula. Obliteration of the common duct of the gland is another result of this extensive suppuration.

8. The diagnosis, during the period of increase of the inflammatory process, is readily made when the site of the tumefaction, the tenderness to pressure, the mobility of the little tumor, and other symptoms are duly weighed. However, when the inflammatory action is extended to the surrounding connective tissue, the trouble may be confounded with a developing simple abscess or with a urinary abscess, but the history of the previous symptoms taken together with the existing urethritis will serve to clear all doubt. After the opening of the perineal abscess, the persistence of a fistulous tract, discharging a viscid fluid, especially a short time anterior to the sexual act, makes it certain that the fistula is connected with the gland or with its duct. But if this fistula discharges urine as well as the viscid fluid, it is equally certain that the urethra also is implicated.

9. The treatment of acute inflammation of this gland at the beginning of its period of increase should consist in the application of five or six leeches to the perinæum, to be followed by the use of the ice-bag for three or four days. If then these means prove ineffective, and there be throbbing pain at the seat of trouble, the gland should be freely incised without delay. This operation will surely give relief even if there should be little or no suppuration, and will be likely to save the urethra from implication. If suppuration has already occurred the

abscess cavity should be thoroughly irrigated with hydrogen dioxide, and the wound suitably dressed. Complete cicatrisation of the wound may be expected in eight or ten days, should there be no complications. In case, however, of urethral perforation, the catheter should be regularly employed to relieve the bladder, and spontaneous urination positively forbidden until the parts are entirely healed. It sometimes happens that the gland's duct is occluded and that there remains a permanent fistula discharging viscid mucus. In such cases the fistulous tract has been injected with nitrate of silver solutions of various strength, and also with tincture of iodine, but to no avail. So there is nothing left to be done but to excise the useless gland. This little operation, which presents no serious difficulty, was first suggested by the French surgeon Gruget, though he never performed it. Nevertheless it is fully justified owing to the annoyance caused to the patient by the constant discharge of the viscid fluid which supplies more and more moisture to the already sodden perineal integument.

10. The treatment of chronic bulbo-urethral adenitis has already been discussed, partly under the head of chronic urethritis.

11. Orchitis, that frequent sequel of acute and chronic urethritis as well as of catheterism, now claims close attention. Orchitis is ordinarily used as a generic term signifying an inflammation which may affect any or all the divisions of the testicle, for it may be confined to the epididymis, or to the body of the testicle, or may affect the whole organ.

12. The relative frequency of epididymitis as a sequel

of acute and chronic urethritis, was stated by Fournier as follows: "Of 222 such cases, 164 were due to acute urethritis, and 58 to chronic urethritis. As to the time of the attack; of the 164 cases due to acute urethritis, 6 began in the course of the first ten days of the urethritis, 15 on the eleventh day, 34 in the third week, 30 in the fourth week, 29 in the fifth week, 19 in the sixth week, 9 in the seventh week, and 21 in the eighth week. Of the 58 cases due to chronic urethritis, 22 began in the third month; the rest of the cases beginning between the fifth month and the fourth year, except one which occurred as late as the seventh year."

13. Epididymitis occurs in about thirty per cent. of all cases of acute urethritis and generally appears on or about the third week; that is to say, during the period of decline of the urethritis, when it has reached the prostatic sinus. But this extension does sometimes occur a few days after the outbreak of the urethritis. The spermatic canal or even the whole spermatic cord becomes implicated in the inflammatory action. In some of these cases, there is but little swelling or pain in the epididymis, whilst in others the epididymis is much swollen, very painful; the pain extending to the inguinal region and even to the abdominal cavity, suggesting the development of a mild local peritonitis. Such cases, designated super-acute epididymitis, reach their height in twenty-four hours. But inflammation of the epididymis is sometimes developed slowly and gradually in six or eight days. Ordinarily, however, it reaches its maximum intensity in the course of three or four days, and is often attended with febrile reaction, nausea, and vomiting. Both testes are very rarely

affected simultaneously. The inflammation may involve only the tail of the epididymis, may be in its body, may be most intense in the head of the epididymis, and may extend to one or both seminal vesicles. Resolution is ordinarily effected on or about the third week, but there often remains some induration at one or two points in the head or tail, or the whole epididymis is sclerosed and finally shrivels. Occasionally the inflammatory process recurs several times in the course of a few months, sometimes on the same side and sometimes on the opposite side. These recurrences are suggestive of the existence of small abscesses in the substance of the epididymis. One of the ill effects of bilateral epididymitis is sterility. This happens when there is chronic inflammation of both spermatic canals; the pus, of acid reaction, destroying the spermatozoa. In some instances, owing to extensive epithelial expoliation, these canals become strictured and are finally occluded, in others practical occlusion happens from pressure caused by the shriveling of a plasmatic nodule at the tail of the epididymis.

14. Inflammation of the body of the testicle and of the epididymis should be specialised for the reason that in didymitis it sometimes scarcely affects the epididymis whilst in epididymitis the body of the testicle generally escapes. This distinction is warranted by the fact that the body of the testicle is sometimes inflamed as the result of violence and that didymitis is said to be an occasional sequel of variola and of parotitis. Didymitis, when consecutive to epididymitis, may be subacute, acute, or super-acute. Its resolution may begin in three or four days, or suppuration and even gangrene

of the testis may supervene, or the inflammation may become chronic. The super-acute form of epididymitis is nearly always accompanied with perididymitis or with parenchymatous didymitis.

15. The sub-acute form of didymitis is not accompanied with much pain, resolves slowly, and often recurs every few weeks. Such relapses suggest the existence of purulent collections in the testis. When, in these cases, the vaginal tunic is adherent, and this is known by the immobility of the testicle, it is almost certain that the pus is nearing the scrotal surface. But sometimes the abscess is encysted, and this is not discovered until the testicle is excised and laid open to reveal a cheesy mass.

16. The acute form of parenchymatous didymitis is attended with great pain which is spread to the surrounding parts and extends up along the spermatic cord to the inguinal and even to the lumbar region, but ordinarily resolves without suppuration. When, however, resolution is delayed the process of inflammation assumes chronicity and the testicle steadily shrivels after the intertubular connective substance and the seminiferous tubules have been filled with plasmatic exudation undergoing sclerous degeneration. Such a morbid condition is often found in the didymitis which has resulted from parotitis, and is not infrequent among boys who have had "the mumps." There is a form of chronic didymitis which leaves the testicle in a state of induration for several months or for a year or two when at length the diseased organ ulcerates its way out and a considerable part of it appears on the surface of the scrotum covered with granulations. This condition,

which has been mistaken for tuberculous or syphilitic degeneration, is styled benign fungus of the testis. In such cases, although cicatrisation finally occurs, the testicle is practically destroyed.

17. The super-acute form of didymitis, of very rare occurrence, is accompanied with great febrile reaction and excruciating pain. It attains its maximum intensity in the course of forty-eight hours when the period of decline of the inflammatory process begins; otherwise the testicle becomes gangrenous and beyond repair. Its entire body being affected and its thick, fibrous investment being inelastic, yields no space for swelling, accounts for the extreme pain and the supervening gangrene. But even when the period of decline is passed and the organ is not gangrenous, it suppurates or undergoes sclerous degeneration and shrivels into a small, hard mass of scar tissue.

18. In the treatment of epididymitis the physician should be guided by the degree of the inflammatory process and by the mental and physical state of the patient. Hyperæsthetic subjects affected with the mildest form of epididymitis often make such outcry about a degree of pain which scarcely evokes a groan from other sufferers, and require, to tranquilise them, the soothing influence of moral suasion or even of the bromides or of morphia. Such mild cases require no local treatment besides suspension of the testicles wrapped in cotton. On the other hand, the pain caused by a super-acute epididymitis, in which the integrity of the testicle is seriously threatened, is scarcely complained of by the more stolid sufferers, and this gives no little anxiety to the physician, who soon realises that

sequence of such incision, but is surely preferable to gangrene, since complete cicatrisation of the wound usually follows. But even under the most favorable circumstances the testicle is permanently damaged by the original inflammatory process.

V

THE SEMINAL VESICLES; THEIR INFLAMMATION*

1. Gonecystitis—inflammation of the seminal vesicles—occurs much more frequently than it is generally supposed, and exists more commonly as a chronic affection often associated with trachelocystitis and prostatitis for both of which it is very often mistaken. Its examination in this place is warranted by the fact of its being associated with many of those cases of epididymitis attended with so much pain as to mask the chief early symptoms of gonecystitis.

2. Nearly all practising physicians have had their share of cases of chronic urethral discharge accompanied with phenomena variously styled "genital hypochondriasis, sexual neurasthenia, diurnal spermatorrhœa, sterility, impotency," etc. The majority of these cases are of chronic gonecystitis. Their cure is very difficult, slow, uncertain, and sometimes impracticable. It is not easy to persuade the patients that the disease is local and that there is no great danger of implication of other organs. Dwelling much upon and magnifying their infirmity, their moral state is soon affected in varying degrees. They are often unheedful of good advice and, after having "gone the rounds" of the regular profession, fall into the hands of greedy charla-

*Reproduced, with alterations and additions, from Lecture XI in "Diseases of the Urinary Apparatus."

tans, whilst some end their days in asylums for the insane.

3. The conscientious observer of human ails having always recognised the importance of a preliminary examination of the physical properties and gross, minute, and relative anatomy of such organs as may be affected is then ready to undertake the task of setting forth their pathogeny, diagnostics, prognostics, and therapeutics; hence the following sketch of the nature and topography of the seminal vesicles.

4. These vesicles, physically considered, are diverticula of the spermatic canals serving as reservoirs of the semen in man and in the majority of other mammalia, notwithstanding the opinion of John Hunter to the contrary. The view that the seminal vesicles are physically diverticula of the spermatic canals is based upon the following facts: The dilated part of the spermatic canals corresponding in longitudinal extent to the seminal vesicles is identical in structure with the seminal vesicles; the same kinds of fibrous, muscular, and mucous coats exist in both; the mucous coat is rugous and reticulated and lined with the same kind of epithelium in both; the same kind of mucus is secreted by the same kind of mucous glands in both; certain expansions and diverticula are found in both; concretions abound in both; and both are tubular in character. The anatomic differences are: The tube of the vesicles is more convoluted than the spermatic canals; the walls of the vesicles are thinner than those of the spermatic canals; the caliber of the tube of the seminal vesicles is greater than that of the spermatic canals; and the seminal vesicles have twice as many pouches as the

spermatic canals. Each vesicle is therefore only an extension of the spermatic canal. In some animals, the dog kind for example, there are no seminal vesicles, the slightly expanded extremity of the spermatic canals doing all that is necessary toward diluting the semen before it reaches the prostatic region of the urethra. The seminal vesicles of a horse, dissected in 1890, did not consist, as in man, of a single convoluted tube with diverticula, but each vesicle was an oblong sac capable of containing at least sixty grammes of fluid. The mucous membrane was rugous at the posterior extremity of the sac and smooth everywhere else.

5. In man, one vesicle lies on the right and the other on the left of the median line, each with a spermatic canal on its inner border, widely separated posteriorly and converging anteriorly to the base of the prostate which is traversed by their excretory ducts and to which their anterior extremities are closely united; the vesicles and accompanying spermatic canals forming two sides of an isosceles triangle and being attached to the lower fundus of the bladder, with it rest upon the rectum. The close relation of the vesicles to the prostate, bladder, rectum, and peritonæum explain how much these parts are liable to be reciprocally involved in disease. When, in its normal state, the bladder is empty, the space between the posterior extremities of the seminal vesicles is seven centimeters in extent, but while this part of the bladder is thus increased in width it loses in antero-posterior extent, for the peritonæum descends to within fifteen millimeters of the base of the prostate, and in some cases even overlaps the base of the prostate. When the bladder fills up with urine the peritonæum

ascends with it and this antero-posterior space is more than doubled, whilst the transverse, that is to say, the space between the posterior extremities of the seminal vesicles, loses two centimeters.

6. Each vesicle has a proper fibrous tunic, and the two have besides a common fibrous envelope containing a considerable amount of smooth muscle tissue, which connects them superiorly to the bladder, while they are attached to the rectum by loose connective tissue. They derive their nutrition from branches of the inferior vesical and middle hæmorrhoidal arteries. Their veins are large and form a plexus which pours its blood into the efferent veins of Santorini's plexus, and which renders excision of the vesicles so bloody and dangerous an operation as it has proved to be. The lymphatic vessels are abundant and end in two trunks on each side which enter certain lymph glands on the sides of the pelvic excavation. The nerves of these vesicles are derived from the hypogastric plexus of the great sympathetic.

7. The seminal vesicles are conical in general outline, their bases are rounded and in close proximity to the recto-vesical pouch of the peritonæum, and their apices are buried in the base of the prostate. They are slightly flattened superiorly and convex inferiorly, and when distended show very distinctly their convolutions which are bound together by connective tissue. They average in measurement five centimeters, and when unraveled twelve centimeters in extreme length, exclusive of their ten or twelve diverticula. The caliber of the tube averages six millimeters. This tube, like the spermatic canal, is made up of three layers: an external, fibrous, a middle consisting of smooth muscle tissue, the thickest

of the three, and an internal mucous layer. This mucous layer is rugous, alveolar, lined with cubical epithelium, and contains cæcal glands such as are found in the terminal expanded part of the spermatic canals. The glands are parallel to each other, are ordinarily single, but here and there are double, triple, quadruple, or even quintuple, converging to a common duct which opens between the rugæ, the clear, mucoid substance which they secrete serving to dilute the semen.

8. Each vesicle has an excretory duct which, uniting with the spermatic canal, forms the common ejaculatory duct, is about sixteen millimeters in length, slightly conical in form and opens by a slit on each side of the veru montanum on the floor of the prostatic region of the urethra. The caliber of this common ejaculatory duct is about two millimeters at its upper extremity; decreasing to about one millimeter at its terminal extremity in the urethra, and is extensible to a marked degree. Its parietes are very thin as compared to those of the seminal vesicle, and its mucous membrane is smooth.

9. The vesicles, as is seen from their peculiar construction, serve the double purpose of reservoirs of the semen and of accessory glands to the genital apparatus, their alveoli, diverticula, and convolutions preventing their entire evacuation during seminal ejaculation. In them the semen is detained long enough not only to be diluted by their mucoid secretion, but for the spermatozooids to attain full maturity. In the semen of men given to excessive venery, immature spermatozooids have been found still inclosed in parent cells. This seems to sustain the view that the spermatozooids do not reach perfection until they have lingered for a time in the lower

dilated part of the spermatic canals and in the seminal vesicles.

10. Besides secreting the mucoid substance to which reference has already been made, the seminal vesicles contain certain very small calcareous concretions, few in number and not constantly found, except in disease. Civiale mentions Carmann, Riedlin, Stalpart Vander Wiel, Hartmann, Meckel, Hemman, and Baillie as having cited examples of calcareous concretions formed in these vesicles, and likewise Mitchell as having found two hundred small calculi of earthy appearance in the right seminal vesicle of a phthisical subject. Rokitansky also spoke of calculous concretions in the vesicles. In addition to these calculous particles there is a great abundance of other concretions, irregular in form and size, nearly colorless in health, amber-colored in disease, very friable, and resembling inspissated mucus. These last-named concretions, whose use is unknown, were carefully studied by Robin, who thought them analogous to the concretions found in the thyroid body, the spleen, the glands of the uterus, the lymphatic glands, and the prostate. These sympexia are found in great quantities also in the expanded extremities of the spermatic canals. Microscopic in dimensions, they are lodged in the alveoli of the mucous membrane, increase in size from inflammation of this membrane, and become sources of further irritation, and even obstruct the excretory duct, as observed in the specimens exhibited. In these specimens the concretions vary from one to four millimeters in mean diameter, and among the specimens illustrating chronic gonecystitis many are oblong, like grains of rice, three by eight millimeters

in size. The large sympexia sometimes consist of aggregations of small concretions cemented by pus and imprisoning spermatozooids, blood, and epithelial cells. They fly to pieces on slight pressure.

11. The apparently normal seminal vesicles of a man, aged thirty-nine years, who had died of pneumonia, were carefully dissected and the contents of the left vesicle examined microscopically, with the following results: The fluid was viscid, of a brownish color, and consisted of mucus, with innumerable spermatozooids, spermatic cells, leucocytes, a few cubical cells, and great numbers of sympexia of a yellowish color, globular in form; some of them about half the diameter of red blood-corpuscles, others of nearly the size of red corpuscles. Here and there these sympexia were aggregated in masses from the two hundredth to the one hundredth of a centimeter in size.

12. The viscid, brownish contents of the seminal vesicles of a man, seventy-three years of age, who died of a head injury, examined microscopically, twenty-four hours after death, consisted of epithelial cells of different forms, polygonal, cubical, oval; a few spermatic cells, many sympexia of amber color, varying in size from one-third the diameter of red blood-cells to that of leucocytes, some of these sympexia were round, the majority polyhedral and irregular, and many of the smallest were aggregated in masses of four, six, eight, or ten. No free spermatozooids were discerned. Other observations gave similar results. The cubical character of the epithelial investment and the existence of mucous glands were verified in the vesicles as well as in the lower end of the spermatic canals.

13. The foregoing account of the nature, uses, and anatomic relations of the seminal vesicles, based upon a great number of dissections and upon a long and careful study of these little organs, in health and disease, is intended as an introduction to the exposition of their morbid states, of their diagnosis, and of their therapy.

14. Gonecystitis does not appear to have attracted much attention until Lallemand published his observations of this affection in connection with "spermatorrhœa," which is often one of its phenomena, while some form of urethritis is almost invariably its exciting cause. Civiale, Vidal, Gosselin, Verneuil, Fournier, Rapin, and other authors, French, German, English, and American, have, to a greater or less extent, discussed the question of inflammation of the seminal vesicles in special essays, general surgical treatises, inaugural theses, or journal articles. Among the essays that have appeared in the latter part of the nineteenth century upon this subject is a paper, with the title of "Seminal Vesiculitis," by Mr. Jordan Lloyd, of Birmingham, in the *British Medical Journal*, April 20, 1889. Each of these writers has contributed his share of labor toward the elucidation of the subject, but much still remains to be done by other workers.

15. This affection is most frequent among men who habitually indulge in excessive venery, and among those addicted to masturbation; either excess rendering the seminal vesicles more or less vulnerable. This vulnerability is owing to abnormal expansion of the ejaculatory ducts, or in constant erethism of their mucous membrane and of that of the vesicles. Acute urethritis carries its virus through the ejaculatory duct and thus

infects the vesicle of one or of both sides, and also through the spermatic canal to the epididymis. However, epididymitis often occurs without gonecystitis and vice versa. Chronic, much more commonly than acute urethritis, is the cause of gonecystitis; but violent catheterism, particularly when a very small instrument enters or tears the ejaculatory duct, is an accident which should be added to the aetical factors of this inflammation.

16. The acute type of gonecystitis which occurs as one of the consequences of urethritis with orchitis is very often overlooked, because the phenomena of the orchitis occupy so much of the patient's attention that the subjective symptoms referable to the region of these vesicles are generally masked by those of the orchitis. Therefore, in order to ascertain the existence or non-existence of acute gonecystitis, it is necessary to put well-directed questions to sufferers from urethritis and consequent orchitis accompanied with discomfort or pain in intrapelvic organs.

17. In acute gonecystitis the mucous membrane of the ejaculatory duct may be swollen to the extent of occluding its lumen, or a good-sized sympexion may be dislodged from the vesicle, forced into and plug the ejaculatory duct, so that in either case pus may accumulate in and greatly distend the vesicle whose attenuated, or perhaps ulcerated walls, are finally perforated, possibly at several points, allowing this pus to infiltrate the ambient connective tissue and to form a vast abscess pointing in the direction of the ischio-rectal fossa, of the bladder, of the rectum, or even of the peritonæum. This process of suppuration belongs generally to the

super-acute or acute inflammation of the vesicles. In the case of sub-acute inflammation there is a minor degree of swelling; resolution being slow or failing, there follows chronic gonecystitis, interstitial as well as parenchymatous.

18. In the chronic type of this inflammation there is occasionally more or less distension of the vesicles which contain large sympexia, as shown in several of the thirty-four carefully dissected specimens exhibited, or the vesicle shrivels sometimes in an extraordinary degree, as seen in three of the specimens, and becomes useless. One specimen illustrates three interesting points: occlusion of the right spermatic canal, shriveling of its accompanying seminal vesicle, and apparently compensatory enlargement of the left vesicle and lower end of the spermatic canal. Another specimen also illustrates occlusion of the right spermatic canal, but probably of recent date, for the seminal vesicle does not appear to have undergone any shriveling.

19. Interstitial is generally secondary to parenchymatous inflammation of the vesicle and is characterised by plasmatic infiltration of the intertubular connective tissue. Suppuration may occur primarily in the intertubular connective tissue, but this can arise only from the destructive action of a very sudden and superabundant exudate. Generally the exudate becomes imperfectly organised, undergoes sclerous degeneration, and the vesicle shrivels. Sometimes the exudate attains higher organisation and the vesicle retains its original dimensions, though its parieties are somewhat indurated. Several of the specimens presented are good illustrations of these points; showing both vesicles to be considerably

enlarged, hard, and filled with large sympexia. The shriveled condition of the seminal vesicles is common in cases of prostatic enlargement which have required frequent evacuative catheterism of the bladder for several years; the patients having had repeated attacks of orchitis with involvement of both vesicles.

20. Of sixty dissections of the seminal vesicles of elderly subjects affected with prostatic enlargement, forty-five pairs of these vesicles were found to be hard and shriveled. The remainder, though not diminished in size, were more or less indurated. In a few instances they were enlarged, and in one they were cancerous. In another specimen, both vesicles were found reduced to less than half the normal size and were nearly as hard as cartilage. A longitudinal incision made into the left vesicle showed the lumen of its tube to be reduced to about two millimeters in diameter, except at the posterior extremity of the vesicle where its walls were attenuated, translucent, and expanded into a cyst containing three grammes of limpid fluid. The right vesicle, which was not incised, presented the same external features as the left. The prostate was much increased in size, very hard, and, for several years had so impeded urination as finally to cause pyelonephritis and death.

21. The symptoms of acute gonecystitis, so far observed, are: Almost constant painful erections of the penis; frequent and painful ejaculations of semen mixed with pus and blood, until the ejaculatory duct is occluded when spermatic colic occurs; pain extending along the urethra to the extremity of the penis (this, however, is an index of coexistent trachelocystitis); difficult, painful, and frequent urination; burning pain

in the perinæum, at the anus, and in the lower end of the rectum; rectal tenesmus; and very painful defecation. Rigors and febrile reaction, and throbbing pains in the rectum indicate suppuration. Retention of urine sometimes occurs in case of great tumefaction of one or both vesicles.

22. The diagnosis of acute gonecystitis is reached through analysis of the symptoms, digital exploration by way of the rectum, and intra-urethral instrumental exploration. The digital examination reveals more or less tumefaction, heat, and tenderness, in the region of the vesicles on one or on both sides, as the case may be. If the swelling is in the form of a single hard oblong tumor extending from the base of the prostate upward, backward, and outward, the presumption is that the inflammatory process has not passed beyond the proper capsule of one seminal vesicle. If, however, there is a diffuse, doughy swelling extending beyond the median line, it is likely that both vesicles are involved, that perforation of their walls has occurred, and that the ambient connective tissue is infiltrated. When one vesicle only is involved in suppuration together with the prerectal connective tissue, the pus sometimes points in the direction of the ischio-rectal fossa. In such cases the rectal exploration indicates the lateral deviation of the abscess. The instrumental exploration through the urethra should be made first with a gum catheter with the object of emptying the bladder. This done, a moderate-sized rectangular steel sound should be carefully introduced. Though the first catheterism may have given some pain, the moment the sound reaches and distends the prostatic region of the urethra and

passes over the veru montanum the most acute burning pain is felt and continues as long as the instrument is retained in position. Without loss of time a finger should be passed into the rectum and pressure made against the sound in order to break up, and cause the expulsion of, any sympexion which may be plugging the ejaculatory duct. Several of the symptoms being common to acute prostatitis, the rectal and urethral explorations are necessary to the distinction of acute gonecystitis from acute prostatitis. The connections of the ejaculatory ducts with the urethra, the seminal vesicles, and the spermatic canals explain how gonecystitis and orchitis may occur at the same time as consequences of urethritis. But, as already said, the phenomena of the orchitis are often such as to mask those of the gonecystitis. It is therefore wise, in cases of orchitis, attended with pain along the spermatic cord, to make a digital rectal exploration of the seminal vesicles which, if found tender to pressure, swollen, and hot, should be treated accordingly.

23. In the treatment of acute gonecystitis the chief indication is to prevent interstitial suppuration. For this end a similar course to that pursued in the management of acute prostatitis should be adopted. After thoroughly cleansing the rectum, three or four leeches may be applied to its mucous membrane in the region of the affected vesicle, with the aid of a tube such as that recommended by Dr. Hughes of Dublin, for leeching in acute prostatitis. When the well-gorged leeches have cast themselves away, irrigation of the rectum with warm water should be made until it is judged that a sufficient quantity of blood has flowed. If it is found

impracticable to leech by way of the rectum, ten or twelve leeches may be applied to anal and perineal regions. Enough blood will thus be drawn to unload the congested prerectal plexus of veins. As soon as possible after either of these modes of local depletion, the lower end of the rectum should be packed with cracked ice. When the ice melts, the water is allowed to flow out, while the anus is slightly stretched open for the introduction of more of the ice suppositories, which process should be repeated as often as every hour while the patient is awake. These frequent applications of ice should be continued two or three days, and longer if necessary.

24. This antiphlogistic treatment is valuable only during the period of increase or of stasis of the inflammation. Begun later, it is apt to be worse than useless. But when employed at the right time and faithfully carried out, much suffering is prevented, and resolution likely to be hastened. Otherwise suppuration occurs and, to hinder the pus from finding an outlet which may be dangerous to the patient, the sooner a free exit is artificially given to this pus the better for his safety. The particular process of relief should be adapted to the condition of the individual and to the extent of the abscess. When it is ascertained by digital exploration that the abscess is not large but well defined on one side or the other of the median line, the presumption is that the pus has not passed beyond the boundary of the proper fibrous capsule of one vesicle. In such a case aspiration through the rectal walls is indicated. The parts should be brought to view by means of a speculum, and a slightly curved aspirating needle, not less than two millimeters in caliber, should be thrust into the abscess and

the cavity quickly emptied and then well irrigated with peroxide of hydrogen. A single aspiration may suffice, but in case the cavity refills, the aspiration and irrigation should be repeated. If, from super-acute inflammation, there is reason to believe that much necrosis of the tissues has occurred, or if the pus has broken through all barriers and has already infiltrated the prerectal connective tissue, a speculum should be introduced, and a free incision made through the rectal wall into the abscess whose cavity should be disinfected and lightly packed with a tent of antiseptic gauze to be renewed once daily. Whenever the abscess is large, and this is likely to be the case in abscesses of very slow formation and development, such abscess is apt to point laterally toward the ischio-rectal fossa. In that case it should be reached by way of the perinæum, as suggested by Mr. Lloyd. The incision may be central or lateral and directed so as to avoid the urethra and rectum. In case of doubt, that is to say, in case, from the extent of the purulent collection, there is a suspicion that both vesicles are affected, it is wise to make a crescentic incision two centimeters in front of the anal margin and deepen the cut by careful dissection between the rectum and prostate; care being taken to avoid wounding the urethra. After thus giving free vent to the pus, the abscess cavity should be well disinfected and loosely packed with gauze, so that the healing process may begin at the bottom of the wound.

25. Chronic gonecystitis, so distressing to the sufferer, often so puzzling to the physician, and of so much greater frequency than the acute form, is worthy of a few notations on its nature and treatment.

26. Although acute gonecystitis often resolves without suppuration, it becomes chronic in a considerable proportion of cases, whilst in the great majority of instances chronic gonecystitis begins independently of the acute type.

27. The common causes of chronic gonecystitis are venereal excesses and masturbation, both giving rise to chronic urethritis, which is the immediate cause.

28. The symptoms of the chronic are similar to those of the acute type, but the suffering is in lesser degree, and there is no febrile reaction. One of the most constant symptoms is a burning, itching sensation in the perinæum, anus, and rectum, such as occurs in the acute type but not so intense though continuous, in some cases, and very harassing month after month and year after year. Another phenomenon is painful spasmodic contracture of the anal sphincter. When a seminal vesicle is in a chronic state of inflammation, there is, ordinarily, a persistent urethral discharge consisting of pus, a little blood, some epithelium, and a few dead spermatozooids.

29. Spermatic colic is another, though not very frequent, symptom of chronic gonecystitis. It is due to the impaction of a sympexion or of several sympexia in the ejaculatory duct and consequent retention of semen, mucus, and pus in the seminal vesicle.

30. Pus intimately mixed with semen is regarded by Christian Smith as a pathogenic symptom of chronic inflammation of the seminal vesicles. The only means, said Dr. Smith, of ascertaining the source of this pus is by examining the semen that has dried on the patient's linen after coitus or after an involuntary pollution.

"The stain made on linen by normal semen is of a uniform grayish-white with a darker border which never contains any element of yellow, while in case of inflammation of the seminal tract the dried stain presents a more or less yellow coloring, either throughout or at the border, which is the most highly colored. When the pus originates in the urethral or prostatic crypts, its mixture is never so intimate as in the first case, and the yellow coloring shows itself in minute zones or in disseminated spots upon the gray stain."

31. The progress of the chronic type of gonecystitis is slow and gradual, tending to complications of more or less gravity, as, for instance, when the ejaculatory duct becomes occluded and allows the secretions to so accumulate as to greatly distend the vesicle and even the spermatic canal. Such cases are of rare occurrence, and their symptoms are not easily interpreted. Dr. Nathan R. Smith, of Baltimore, reported, in *The Lancet*, Vol. 2, p. 558, 1872, with the title of "Hydrocele of the Seminal Vesicle," a case of cyst of the left vesicle which filled the pelvis and extended into the abdominal cavity to a point above the umbilicus, and was at first mistaken for retention of urine. The cyst was tapped by way of the rectum and ten pints of a brown, serous fluid drawn. In four weeks the cyst filled again and was again tapped. This time it did not refill. Reference to this case is made by Mr. Lloyd in his excellent paper. A remarkable example of dilatation of the spermatic canal is recorded by Troussel-Delvincourt in the *Nouveau Journal de Médecine*, October, 1820. In that case the right spermatic canal formed a cylinder measuring nearly five centimeters in diameter, soft, smooth, filled

with a thick, pulpy, yellow material similar to that of softened tubercle. The seminal vesicles contained a similar but less consistent material. These two are very exceptional cases, for dilatation rarely exceeds twice the normal caliber of the vesicle or spermatic canal, as shown by the specimens just exhibited.

32. Sub-acute and chronic inflammation sometimes end in calcareous infiltration of one or both vesicles and spermatic canals. Among the specimens exhibited is a good illustration of calcareous infiltration of the spermatic canals.

33. Since inflammation of the spermatic canal is ordinarily associated with gonecystitis, sterility is one of the sequels of the chronic type when both sides are affected; the spermatozooids being destroyed by the abnormal secretions of the spermatic canals and seminal vesicles. When the two spermatic canals or the two ejaculatory ducts are permanently occluded, impotency is the result; erection of the penis being imperfect and sexual desire finally extinct.

34. In elderly men, as seen by the results of the dissection of sixty pairs of seminal vesicles, there is often shriveling of the vesicles due to chronic inflammation. In younger subjects the chronic inflammation is generally confined to the mucous membrane, and the vesicles are more likely to be dilated and filled with large sympexia. In several of the thirty-four dissections first mentioned a sympexion was found blocking the ejaculatory duct. In these younger subjects the symptoms are ordinarily distinct, whilst in elderly men they are frequently wanting, and the altered condition of the vesicles is ascertained only at the necropsy.

35. The treatment of chronic gonecystitis should consist in endeavors to cure the existing chronic urethritis, and in emptying the distended vesicle by pressure with the finger passed into the rectum. This may be followed by very warm enemata and the occasional use of rectal suppositories of belladonna and opium, ten centigrammes of the first and twenty of the second drug. From time to time the passage into the urethra of a steel sound and digital compression thereon through the rectum should be resorted to for the purpose of effecting the expulsion of such sympexia as may be lodged in the ejaculatory duct. This process should be employed as well for purposes of diagnosis as for relief at the same time; the extraction of the sympexia allowing the distended vesicle to be emptied and thus relieving a painful spermatic colic.

VI

URETHRAL STRICTURES; THEIR NATURE AND DIAGNOSIS AND INDICATIONS OF TREATMENT

1. Angustia, coarctation, stenosis, and stricture, are the terms applied to the condition of a urethral canal whose caliber, at some particular point or points, is lessened, owing to a morbid state caused by localised chronic phlegmasia, loss of substance, contusion, or laceration. Such narrowing, in general, is slowly progressive, and, unless treated early, the lumen of the constriction is finally reduced in diameter to less than a millimeter. Some congenital malformations of the urethra are sometimes attended with more or less narrowing of the canal, or even imperforation of the meatus.

2. Although several eminent writers have insisted upon the existence of spasmodic and inflammatory strictures, this notion can scarcely be regarded as tenable. The spasms, which very frequently occur even in recently stenosed urethræ, either during urination or catheterism, surely do not constitute the lesions now recognised as strictures which are so often the cause and not the effect of these spasms; and acute inflammatory swelling of the urethral mucous membrane is generally the effect rather than the cause of its coarctation.

3. Urethral strictures are now of less frequent occurrence than they were during the second third of the nineteenth century. This utterance will not seem

strange if the modes of treatment of urethritis employed up to that time and the improved methods that followed, be contrasted. The so-called abortive treatment of acute urethritis, by the injection of six or eight per cent. silver nitrate solutions, was a prolific cause of stricture, as was also the use or rather abuse of other caustic solutions, such as strong solutions of mercuric or zinc chloride, which excited a superabundant epithelial exfoliation and increased the extent of the acute phlegmasia even to the spongy substance of the urethral canal. Realisation of the evils of these rash processes at length brought about a radical change in treatment. Injections were given up for the oral administration, in very large doses, of copaiba balsam or of powdered cubebs, designed to act through the urine. This large dosage was often detrimental to the kidneys and generally failed to fulfill the promise of speedy relief; the urethritis becoming chronic and confirmed stricture ensuing. All that need be said of the modern treatment of urethritis is that it insures a comparatively quick cure without doing violence to the mucous membrane or to its underlying tissues, and, in a great measure, is preventive of stricture. However, there are still very many angustiæ due to neglect or to the heroic treatment of urethritis, so often attempted by the patients themselves, to occupy much of the physician's time and to demand of him an abundant supply of bougies and of other needful instruments.

4. Very narrow strictures, the so-called impassable, are also of less frequent occurrence than formerly, and rupture of the urethra, behind a stricture, followed by infiltration of urine in the ambient connective tissue, is

rarely met with in our days. The comparative rarity of these grave conditions is accounted for by the fact that, for many years past, strictures have been more commonly treated during their formative stage. The value of early prophylactic treatment needs no commentary.

5. The most frequent cause of stricture is neglected or improperly treated urethritis. Among other aetical factors are the too frequent, the violent, and the careless uses of bougies—even when these instruments are uninfected—in the treatment of other disorders of the urinary organs, such as cystitis and chronic retention of urine. The excessive use of ardent spirits, of beer, of new wines, and the abundant ingestion of certain other irritants, are at least indirect causes. Indeed all these abuses give rise not only to urethritis with consequent narrowing of the urethra, but, as in the case of unduly frequent catheterism, to induration of the whole canal.

6. The true pathogeny of stricture was unknown until after the middle of the nineteenth century. Anciently the general belief was that urethral obstruction was due to the existence of "excressences, caruncles, carnosities, or callosities," for the destruction of which divers instruments, ointments and escharotics were employed by Paré and his contemporaries who had accepted the theory. But a century later Dionis* appears to have been the first to question this notion concerning "excressences," etc., as the cause of urethral obstruction, and said substantially that, in many dissections of the parts, where these "caruncles" were supposed to exist,

*Cours d'operations de chirurgie 5 ième edit. Paris, 1765, p. 272.

he had failed invariably to find any of these "caruncles, carnosities," etc., but had discovered distinct local narrowings of the canal, caused, as he thought, by the cicatrisation of ulcers of the mucous membrane due to virulent urethritis. Others reached the same conclusion, but the erroneous notion regarding the mythical "excressences," etc., continued to be entertained down to the latter part of the eighteenth century, when Benjamin Bell* gave his help toward the firm establishment of the theory of local narrowing of the urethral canal as a sequel of urethritis; saying that this narrowing occurs in two different ways: first, by mere tumefaction of the mucous membrane; second, by contraction, as if a cord were tied around the urethra. The theory of "carnosities" having been given up, the notion of a swelling of the mucous membrane remained fixed in the minds of physicians, among whom was Jules Guérin, who flourished during the first half of the nineteenth century and who was a believer in, and a propagator of, the theory of a special inodular tissue peculiar to urethral strictures. These theories of the development of stricture were all demolished by Désormeaux,† who, in 1865, published his observations on the diseased urethra with the aid of his endoscope, which revealed a local granular condition regarded by him as the real beginning of stricture, and said: "If we consider urethritis and the consequent stricture as a single affection, whose evolution begins at the moment of contagion and continues to the organic stricture, we are led to recog-

*On Gonorrhœa Virulenta, etc. Edinburg, 1793. Vol. 1, pp. 258, 259.

†De l'Endoscope et de ses applications au diagnostique et au traitement des affections de l'urèthre et de la vessie. Paris, 1865.

nise, in the progress of this ailment, three different epochs, to each of which belongs a particular kind of stricture. The first epoch is that of the urethritis or of the acute inflammatory stricture; the last epoch answering to the confirmed fibrous or inodular stricture. Between these two extremes is an intermediary epoch which originates in the first and prepares the third." It was in this middle period that he discovered, with the aid of the endoscope, the localised chronic inflammation with granulations and therefore named it granular urethritis.

7. The first or formative stage of urethral stricture, according to the views of Désormeaux, which are correct in the main, is granular local urethritis. In this chronic condition the mucous glands disappear and the membrane loses its identity at the seat of the disease; its epithelial investment soon ceasing to afford any protection against the irritating urine, as most of the cells are cast off before they are fully developed.

8. The second stage is characterized by cell-proliferation in the meshes of the mucous membrane and in the sub-mucous connective tissue and sometimes multiply so rapidly as to cause some swelling and consecutive diminution of the urethral caliber. This state is termed "chronic inflammatory stricture" by Désormeaux.

9. In the third stage the new cells had been transformed into fibrils gradually undergoing sclerosis, which process really constitutes the true organic stricture. In this kind of stricture, the mucous membrane, sub-mucous tissue, the spongy substance, or all three may be involved. In an advanced period of this third

stage the contracted part of the urethral canal has a nacreous appearance as seen in life through the urethroscope and still more distinctly when the urethra is opened post mortem. This nacreous look and the almost cartilaginous density of the strictured part, are due to advanced sclerous degeneration of the fibrillæ and of the ambient connective tissue; the mucous membrane having long before lost its mucous follicles and its normal epithelial investment. These facts are worthy of particular note in relation to treatment.

10. It is clear, then, that urethritis is the real germ of such strictures, that without treatment or with unsuitable medication, the phlegmasic process is continuous from incubation to confirmed stricture, and that when the acute urethritis is rightly treated and speedily and completely cured, the nascent stricture is nipped in the bud. Therefore, in general terms, it may be said that acute urethritis is a stricture *in posse*, and that chronic urethritis is a stricture *in embryo*.

11. After acute or sub-acute urethritis, stricture is generally of slow formation, and, in some cases, many years pass before the urethral caliber is markedly reduced; while super-acute urethritis with involvement of the spongy substance, and "chordee," often gives rise in a few months, to rapidly contracting and distressing strictures.

12. The so-called inodular tissue said to be peculiar to stricture has been relegated to the myths of pathoanatomy ever since it was made clear that the stenotic process following chronic urethritis is the effect of inadequate repair of local epithelial exfoliation and the consequent formation of a scar-tissue that is progressive-

ly undergoing sclerous degeneration and contraction precisely as does the scar-tissue in the repair of loss of substance of other mucous membranes or of the skin and underlying tissues destroyed by severe burns.

13. The inodular masses often seen and felt near old strictures are generally due to inflammatory action outside the urethral canal consequent upon the escape of a drop or two of urine through an ulcerated spot in the distended part of the canal behind the stricture. The slight infiltration of urine in the peri-urethral connective tissue causing not only the kind of induration in question, but the formation of small abscesses and finally of urinary fistulæ. It is therefore plain that these inodular masses have no direct relation to the sclerosis which had given rise to diminution of the urethral caliber.

14. The chief forms of strictures are the linear, the annular, and the tortuous.

15. The linear form is due to a sclerosed duplication of the mucous membrane or to a thin diaphragmatic septum, sometimes with a central, often with an eccentric lumen. Occasionally only a part of the circumference of the urethral canal is involved. The extreme variety of this form is found in the transverse bands or bridles which rarely occur in the urethra.

16. In the annular form the constriction is such as if a cord were tied around the canal. These strictures are of variable length and often multiple, sometimes involving the whole extent of the phallic region, but do not ordinarily exceed a centimeter longitudinally. The lumen is commonly eccentric, seldom central.

17. The tortuous form is of very frequent occurrence. Its devious course is due to irregular contraction of the

sclerosed tissues. Such strictures vary in length from one centimeter to three and a half centimeters, and the distal end of their lumina is eccentric.

18. Strictures of all these varieties of form are met with in different stages of development, and these stages have been mistaken for distinct species of the disease—there being in reality but three species, the first congenital, the second, arising from urethritis, and the third from injury. Those of recent and rapid formation are generally soft and yielding as compared to those of slow maturation and long existence, which are often extremely resilient. The induration in the last-named may be much increased by some slight injury or by unsuccessful catheterism. When the spongy substance of the urethra is involved, especially when "chordee" has been an accompaniment to the original urethritis, the induration is often very great. The sclerotic process in that case is very much more pronounced along the floor of the canal than elsewhere.

19. The common localities of strictures are: the sinus of the bulb; the balanic region; the scrotal region; the phallic region. They are very rarely found in the membranous region, and it is only of late years that, in this situation, they have occurred with less infrequency. They are of course traumatic, and consecutive to the tearing of the urethra from the prostate by violence inflicted during digital dilatation in median lithotomy and also during enucleation of diseased prostatic glands. In this situation strictures are likewise liable to occur from electro-cauterisation intended to act upon the prostate at the vesico-urethral opening.

20. Of two hundred and seventy preparations, ex-

hibiting three hundred and twenty strictures, examined by the late Sir Henry Thompson, sixty-seven per cent. of the entire number of these strictures were in the region of the bulb; sixteen per cent. were in the region included between the bulb and a point two inches and a half from the external orifice; and seventeen per cent. in these anterior two inches and a half, including the external meatus.

21. Multiple urethra strictures are not uncommon, judging from the testimony of divers observers. Hunter found six in one urethra; Lallemand, seven; François Eolot, eight ("callosities"); and Leroy, eleven, by exploration with his *bougie-à-boule*. It is rare to meet with more than three. In three instances, however, the writer found four; one being at the external meatus, the others following in intervals of about two and a half centimeters. Frequently there are two, one at or near the meatus, and the other in the phallic, but more commonly in the perinæal region.

22. The progress of stricture due to urethritis, as already suggested in Note 11, is ordinarily slow; in some instances three, four, five years, or even a much longer time expiring before the patient begins to suffer serious inconvenience in urinating, or before he is seized with retention of urine. Urethral strictures do not get well spontaneously, nor are they curable, as believed by some persons, through constitutional treatment alone. The retraction of sclerosed tissues, unless checked by early mechanical means, continues until the lumen of the stricture can barely admit the smallest bougie. Occasionally, however, there are cases which pass through all their stages in a few months from the irruption of

a urethritis, particularly when painful "chordee" has occurred. The progress of traumatic strictures is even more rapid than in the last-named instances. Congenital strictures are not progressive except when very narrow. They are then aggravated by the contact of dammed up stale urine which causes a chronic local urethritis and progressive contraction of the already narrow passage.

23. Among the chief symptoms of confirmed stricture are: chronic purulent urethral discharge; frequent, difficult, and painful urination; retention of urine; and grave alterations in the urinary secretion.

24. Chronic urethral discharge is the earliest and most lasting of the symptoms of stricture. It is first observed by the patient who discovers the glueing of the meatus when rising in the morning to urinate. During the day the discharge may not exceed a drop or two of thin pus which in time escapes his detection, but the presence of pus in the urine is generally recognized through microscopic inspection. The dictum "no gleet without stricture" should be reversed into no stricture without gleet; several of the gleety discharges being due to other conditions of the urethra than its narrowing as already indicated under the heads Chronic Urethritis, Bulbourethral Adenitis, and Gonecystitis.

25. Frequent urination by day and by night is one of the prominent symptoms of stricture although it occurs in cystitis from other causes. It is generally accompanied by more or less smarting, burning, scalding pain; dysury increasing as the lumen of the stricture decreases in caliber; the stream becoming thready and later the urine passing drop by drop with much straining, and

finally dribbling involuntarily from over-flow which has too often been mistaken for incontinence, and which in reality is retention of urine.

26. Ordinarily, there is no material change in the amount of urine secreted when urination is unduly frequent. Sufferers sometimes interpret frequent urination as excessive renal secretion, and, under that impression, are wont to abstain from the ingestion of liquids hoping that the amount of urine would be decreased. In this, of course, they are disappointed, whereas those who make free use of diluent drinks are comparatively exempt from scalding pain in urination; the urine, in a measure, losing its irritating properties without being much increased in quantity. It is only in the far advanced stages of stricture with renal involvement that there occur extreme alterations in the amount of urine excreted; it then may be markedly diminished, or may be inordinately increased in quantity.

27. In quantity the urine is altered in certain cases of long standing strictures when there is in the bladder residual, stagnant, stale, decomposing, ammoniacal urine causing much irritation and painful cystitis; the urine becoming extremely viscid from action of the constantly developing carbonate of ammonia upon the contained pus. This viscid, intolerably fetid urine, is dark or even chocolate colored from the presence of blood.

28. The sequels of neglected stricture of the urethra are: alterations in the walls of the canal, and lesions of the prostate, of the bladder, of the ureter, and of the kidneys. These morbid conditions are more or less serious, and their early detection is of much importance in respect to treatment and prognosis.

29. The urethral walls, both in front and behind narrow strictures, are often inflamed to a high degree and very sensitive to the passage of the urine and of instruments intended for exploration or dilatation. Rarely is the urethra expanded in front of old strictures, but it is almost always so behind these obstructions; the mouths of the mucous follicles and of other ducts being much dilated. These changes are due to the pressure of the dammed up urine which can escape in but a very small stream, or only in drops, while the irritated, gorged bladder is doing its utmost to be rid of its burdensome contents. This expansion of the urethra is sometimes so great that the ampulla has reached the capacity of an ounce or even more of stagnant urine. The walls of the ampulla being thin and often ulcerated in small patches, favor the escape of a few drops of the stale urine into the ambient connective tissue, and the consequence is the formation of an abscess which, opening spontaneously or otherwise, gives issue to purulent urine; the result being a scrotal or a perineal fistula.

30. When the lumen of a stricture happens to be plugged by thick pus or by a bit of gravel, or otherwise blocked, and the patient makes a strong effort to relieve the distended bladder, the attenuated walls of the ampulla burst and a flood of urine is extravasated and fills the connective tissue spaces in the perinæum, scrotum, penis, and sometimes extends even to the hypogastric, lumbar, and thoracic regions. On rare occasions, instead of the urethra, the over distended bladder bursts during a violent effort of the patient for relief, or simply from a sudden influx of urine from the kidneys, the effect of which the weakened vesical walls could not resist.

31. The prostate suffers more or less in consequence of the extension of the persistent urethral phlegmasia behind strictures of long standing, and also from the ill effects of violent or unduly frequent catheterism. In acute prostatitis, from these causes, abscess formation is not uncommon, and the pus finds exit by the urethra, the perinæum, or the rectum. In very rare instances the prostate is diminished in size or shriveled as a consequence of long neglected urethral stricture.

32. The alterations of structure in the bladder from old strictures are due mainly to retention, stagnation, and decomposition of urine. Incomplete retention of frequent occurrence, causes thickening of the bladder walls sometimes with markedly diminished retentive capacity; the muscular coat increasing in thickness even to the extent of one inch, with bold, fleshy columns of its reticular layer not unlike those of the left ventricle of the heart; the mucous membrane being in a state of intense congestion and even of disseminated ulcerations; and the phlegmasic action arising from the stale urine, swarming with infective organisms, extending to the ureters, the renal pelves, and the kidneys.

33. The generative function also is more or less impaired as an effect of long standing close strictures of the urethra; the phlegmasic action being propagated through the ejaculatory ducts to the seminal vesicles, spermatic canals, and testicles.

34. Besides the many lesions already named, some of the remote effects of urethral strictures are felt by the general nervous system and have been recognized and styled as urinary neuroses. Patients so affected complain of neuralgic pains in the loins, in the hypogastrium,

and in the course of several nerve trunks such as the ileo-scrotal, obturator, crural, and sciatic. Luxmoor, who flourished early in the nineteenth century, appears to have been among the observers who first called attention to these signs as indicating disorders of the urinary organs. Sir Benjamin Brodie later related the case of a patient, affected with stone in the bladder, who had no other symptom of the complaint save a persistent sciatica on the left side; the distress extending to the heel, where it was most pronounced. There are many more neurotic manifestations connected with urethral and vesical diseases which need no special mention in this brief summary.

35. For diagnostic purposes, absolute dependence is not to be placed upon the symptoms of stricture, since many of these symptoms are common to those of other obstructions to the expulsion of the urine and also to those of vesical disorders which are not the outcome of coarctation of the canal. Direct exploration, therefore, is the surest way of arriving at a correct diagnosis as to their caliber, number, site, and form.

36. The idea that urethral obstructions were caused by "carnosities or excressences" having been dismissed and the theory of constrictions accepted, the next step was to ascertain the exact site, and caliber of such constrictions. For that end metallic sounds were employed, but gave no information other than the existence of an obstruction, and, unless used with the greatest care, were liable, after passing the stricture, to inflict serious injury at the bulbo-membranous junction, while at the same time leading to the false impression of the existence of a stricture at that point. So, recourse was had,

by Ducamp, Civiale, and others, to wax bougies for taking impressions of strictures and thus determining their site, caliber, and form; and Bigelow, long afterward, with the same object in view, suggested the use of gutta-percha bougies. But all these and many other tentative modes of diagnosis, being tedious and otherwise unsatisfactory, were abandoned and the simpler method of Sir Charles Bell revived and modified.

37. In his *System of Operative Surgery*, published in the year 1807, Sir Charles described certain metallic "ball probes" designed to measure the caliber of strictures and their distance from the external urethral orifice. The "ball probes" were slender silver or gold wires with spherical extremity, "varying from the full size of the urethra to what will just pass the narrowest stricture." Their use was believed to be safe enough owing to the thin stem, but the extremity being globular its passage through the constricted urethra was not easy. With stiffer stems the "ball probes" would lose in delicacy of manipulation without exemption from danger. What was lacking in them for efficient and safe exploration was afterward supplied by an ingenious contemporary.

38. Bell's ball probes or urethra sounds were happily modified in 1845 by Leroy (d'Etiolles), under the designation of *bougies-à-boule*, made of soft, flexible material. They were first known as gum bulbous bougies, though containing no gum and not being bulbous, but acorn-shaped at the extremity; the base of the acorn being continuous with the shaft of the instrument, which is two or three sizes less in diameter than the base of the acorn. These bougies are now made of silk webbing thickly coated with an elastic varnish and vary in size

from No. 2 to No. 15 of the English catheter scale. They should not be confounded with olivary bougies, which are used for dilatation of strictures, while the acorn-tipped are of no other use than for exploration. Some of these bougies have only a half acorn cut in its long axis for the recognition of certain bridiform strictures involving but a part of the circumference of the urethral canal. Others have one and even two additional enlargements along the shaft, and were suggested by Phillips for the detection of multiple strictures, but these "knotted bougies," as they are called, possess no special value over the original single-acorn tipped bougies.

39. The manner of using this exploring bougie is as follows: one of a size sufficient to fill the meatus, having been suitably lubricated, is passed onward slowly and gently into the urethral canal until it is arrested by a constriction. In withdrawing it the stem is marked at a point corresponding to the meatus, and the distance of the stricture in the canal is thus ascertained. Smaller bougies are substituted to determine the length and diameter of the coarctation. This is accomplished by leaving in for a moment the bougie which has passed the obstruction, and then slowly withdrawing it until impinged by the stricture, owing either to spasmodic action or resiliency. The length of the stricture is then ascertained by adding to the measurement indicating its anterior extremity the space between this and the base of the impinged acorn of the smaller bougie. The detection of linear and bridiform strictures is too easy to require any description. The eccentricity of the lumina and the tortuosity of certain narrow strictures are determinable by means of elbowed filiform whalebone bou-

gies. Acorn-tipped bougies are serviceable to localise those tender spots in the urethra indicating the granular condition which is the formative stage of stricture. In such cases the base of the acorn when withdrawn is found coated with pus. Metallic, bulbous bougies are generally discarded as explorers because they lack the flexibility and delicacy characterizing the silk-web bougies, and because their use is not free from danger.

40. Sufferers from urethral stricture require general as well as local treatment; the general medication being a very essential preparation and adjunct to the surgical processes employed for remedying existing impediments to the free flow of urine. The general medication is addressed to complicating disorders, to the improvement of the more or less impaired functions consequent upon the local affection, to the frequent accompanying neuroses, to the alterations in the character of the urine, to the relief of pain, to the allayance of local spasm, and to the insurance of nocturnal sleep.

41. The rational local treatment of urethral stricture should be based upon a correct appreciation of the general physical condition of the patient, of the cause, duration and nature of the disease, of the form, site and degree of the constriction, and of existing complications, besides a thorough familiarity with the mechanism and care of the necessary instruments. Therefore, the physician should make no absolute rule for the management of his cases, but be guided by the knowledge he has acquired in the observation of the phases of the complaint. This surely will lead him to a proper discrimination in his choice of treatment in the difficult cases, while in the ordinary he will find dilatation a

safe and certain measure. The main objects, then, of these considerations are to recall attention to the well tested methods of dilatation employed so successfully in the relief of sufferers from urethral stricture, and to the indication of other modes of treatment when dilatation is not practicable.

42. A short rehearsal of the adaptation of special modes of treatment in different varieties of strictures seated in the balanic, phallic, scrotal, and perineal regions of the urethra will suffice for present purposes.

a. Strictures at the meatus and in the balanic region, being ordinarily dense and refractory to dilatation, require incision.

b. Strictures in the phallic region that are of long standing, indurated, resilient, refractory to dilatation, require internal incision.

c. Strictures in the anterior half of the scrotal region that are narrow, indurated, resilient, and refractory to dilatation require internal incision.

d. Strictures complicated with false routes that render catheterism difficult and dangerous ordinarily require internal incision when seated in the phallic or in the anterior half of the scrotal region, and external incision when in the posterior half of the scrotal or in the perineal region.

e. Strictures in the perineal region that are narrow, indurated, resilient and refractory to dilatation or to divulsion require external incision.

f. Strictures in the perineal region that are narrow, and complicated with fistulæ and extra urethral inodular masses, require external incision.

g. Strictures in the perineal region that are com-

plicated with abscess formation or with extravasation of urine, require immediate external incision.

h. Traumatic strictures in the perineal region require early external incision.

i. Laceraton of the urethra from perineal injury, being a stricture in embryo, requires immediate external incision.

k. All other urethral strictures are generally amenable to dilatation or, at least, to divulsion.

l. Strictures in regions of the urethra heretofore exempt from this affection are likely to occur with more or less frequency, now that enucleating and cauterising operations upon the prostate are so commonly performed. The site of constriction in the one case will then be the membrano-prostatic junction, and its cause the severance of the membranous urethra from the prostate when undue force or awkwardness is used in enucleating masses of diseased prostatic glands. In the other case the site of the stricture may be at the urethro-vesical junction or wherever else in the deep urethra electro-cauterisation may destroy enough tissue to leave a progressively contracting scar.

VII

URETHRAL STRICTURES; THEIR DILATATION AND DIVULSION

1. The idea of enlarging the obstructed urethral canal by destroying the supposititious "carnosities" can not well be traced beyond the time of Alfonso Ferri, of Naples, who said, in a work published in 1553, that as early as 1548 he had used for that purpose, cylinders coated with a special unguent; although Alexander of Tralles (sixth century) mentioned the use of such unguent for like purposes. For exploring and dilating the urethra Ferri employed stems of malva, parsley, and fennel, also flexible leaden cylinders. Andrea Lacuna, Amatus Lusitanus, Aldereto, Petronius, Paré, and others made use of cylinders of wax with a central wick for the diagnosis and treatment of "caruncles or carnosities," and coated these cylinders in certain spots with some "escharotic ointment." That sort of treatment was abandoned when Dionis, more than a century later, had exploded the "carnosity" theory; but it was revived by Daran, who, in 1748, published his observations on the diseases of the urethra, advocating the treatment of strictures by medicated bougies, but it was soon shown by thoughtful and able surgeons that the reported cures were not due to the medicated part of the bougies but to the mechanical dilatation effected in their passage through the constrictions.

2. Long after the abandonment of the idea of "carnosities," and the acceptance of the theory of organic stricture, there arose certain heresies regarding the treatment of urethral obstruction among which was the cauterisation of strictures with solid nitrate of silver, potassa fusa and other escharotics. This treatment was strongly advocated by such lights of science as John Hunter, Sir Everard Home, Sir Charles Bell, Whately, Ducamp, Leroy, and many other physicians almost to the end of the first half of the nineteenth century. Another still later heresy, productive of as much harm as the first-named, was the treatment of urethral stricture by electrolysis. Cauterisation was employed before the true pathogeny of stricture had become known, but there was no such excuse for the introduction of electrolysis, whose promoters offered no tangible scientific reason for its use. Both of these methods of treatment are known to have been followed by the gravest urethral lesions which fully warranted their rejection by the best surgeons.

3. The notion of causing absorption of a supposed inodular tissue constituting stricture is surely contrary to the tenets of the modern pathogeny of stricture, for, in the vast majority of narrow constrictions following urethritis it has been shown that the mucous membrane and its underlying connective tissue only are affected, and, as already said, instead of a thick ring of inodular tissue, there is sclerous degeneration of a mere film of scar tissue. Therefore there is nothing requiring absorption, but on the contrary there is need of regeneration of tissue, effected even in the worst cases by making, at the seat of disease, in the long axis of the urethral

canal, an ample gap which is soon filled with granulations that gradually become organised. The urethra is thus spliced by new scar tissue, and the splice is kept as wide as possible during the healing process by the persistent periodic employment of dilating instruments, the use of which is continued very long after the cicatrix has seemed to cease contracting.

4. The great majority of strictures being amenable to the milder measures of treatment, it may be well now to summarise the principal modes of dilatation, to wit· *a*, gradual; *b*, continuous; and *c*, rapid dilatation.

5. *a. Gradual dilatation* is indicated in the formative stage of strictures due to urethral phlegmasia (which is rightly regarded as a stricture *in posse*); in fully formed strictures that bear the expansion made with the aid of an olivary bougie or a conical sound introduced slowly and gently by a light hand; in those that have been rapidly dilated or divulsed to a certain, but not sufficient, extent, this gradual expansion serving as after-treatment to these processes when it is not judged wise to carry them beyond safe limits; and, it may be added, in long-neglected cases with involvement of the upper urinary passages when a bloody operation would be likely to prove fatal. In such cases the object of the dilatation is only to relieve suffering or prolong life.

6. This dilatation is ordinarily effected by the cautious introduction of duly sterilised soft olivary bougies, and later of conical steel sounds. The seat and caliber of the stricture having been ascertained by the use of an acorn-tipped soft explorer, a flexible olivary bougie, one size larger in its shaft than the base of the explorer's acorn, is well lubricated and slowly introduced, until it

reaches the bladder, and at once withdrawn. In two days the operation is repeated with a bougie one size larger, and so every second day the process of dilatation is renewed until No. 12 or 13 (English scale) is reached; after this it is best to use conical steel sounds whose introduction, by a skilled operator, gives less pain than that of the larger-sized soft bougies.

7. When it is desirable to overdistend the strictured part of the urethra, the extent of such distension is determined by the ascertained caliber of the normal parts of the canal in each case, for the urethral caliber is as variable in different individuals as are the form and dimensions of the other organs of man's body. If the normal diameter of a urethra be eight millimeters, the strictured part may be safely distended to ten millimeters and a half, and if, in another case, this diameter be six millimeters and a half, then the distension of the strictured part need not exceed eight millimeters. It should be remembered that the restoration, as nearly as possible, of the urethral suppleness is as essential as the dilatation of the diseased part. Extreme overdistension and unduly frequent catheterism with very large instruments not only defeat the precious object of restoring the wonted suppleness, but cause a sclerotic change in the urethral structure destructive of its elasticity. This extreme overdistension, so often practiced of late years, can not be too strongly condemned.

8. In its early stages, stricture due to urethritis may be cured permanently in a few months by the simple process of gradual dilatation, but in the case of a confirmed, callous stricture, many months, or even years, of the persistent use of dilating instruments will be re-

quired to maintain the effected calibration, no matter what may have been the nature of the treatment employed to secure the needed calibration of the canal. Such has been the experience of many physicians who have had much to do with sufferers from stricture of the urethra.

9. Confirmed, but not very narrow or resilient strictures are ordinarily cured by gradual dilatation which, however, when carried to high numbers of the catheter scale, does not merely stretch but does split the mucous membrane and break up the fibrillæ of the scar, and this divulsion is made manifest by the slight hæmorrhage which follows the last catheterism. At this moment two or three larger instruments should be passed in quick succession to insure the desirable extension of the resulting gap, which should then be kept patent by periodical dilatation until the parts are completely healed, and for many months thereafter.

10. *b. Continuous dilatation* has been confounded with a process styled by Dupuytreu "vital dilatation," which consisted in holding a sound or catheter against the face of the stricture until it began to yield to the slow pressure, causing a "vital modification" of the disease tissues. The theory was accepted in the time of the eminent surgeon and was current long after when knowledge of the pathogeny of urethral stricture had made but little progress. But in our days the operator looks for a satisfactory result only when an instrument can be passed through the stricture and left in position to effect continuous dilatation, which is often wrongly designated "vital dilatation," although so different in principle and action.

11. Continuous dilatation is indicated in cases of narrow strictures that are unyielding to ordinary dilators and threaten retention of urine. The term continuous dilatation is used partly to express the idea of the action of a soft bougie or catheter retained in the urethra; the presence of the instrument for from a few hours to one or two days having the effect of softening the stricture and of rendering it sufficiently expansible to permit its further dilatation with ordinary bougies, or to admit the shaft of a divulsor or the concealed blade of a urethrotome, and so facilitate its divulsion or its incision. This process is, therefore, only a preparatory step to gradual dilatation, to rapid dilatation, to divulsion or to urethrotomy, and should not be employed longer than two or three days, otherwise urethral ulcerations and other untoward effects may be expected. The continuous dilatation of narrow strictures is ordinarily effected with safety by observing the following directions: A bougie or catheter only a little smaller than the lumen of the stricture is passed and retained in position six or eight hours. It is then withdrawn and another slightly larger substituted and retained six or eight hours, and so until three or four such changes have been made. The moment the stricture begins to yield, the operator proceeds with further dilatation, or with whatever other mode of relief his judgment may dictate. In case, however, the stricture is refractory to this continuous dilatation in the first twenty-four hours, a gum catheter is passed and retained undisturbed for forty-eight hours, at the end of which time, as a general rule, the obstruction will be permeable to such instruments as may be required.

12. *c. Rapid dilatation* is indicated in those narrow strictures that threaten to cause retention of urine. By rapid dilatation of a stricture the writer means the expansion of the constricted part of the urethra to two, three or four numbers of the catheter scale at one sitting. For instance, if the stricture first admit a No. 1 bougie, this is succeeded by Nos. 2, 3, 4, and at the next sitting, in two days, Nos. 6, 7, 8, and so at each subsequent sitting Nos. 9, 10, then 11 and 12, when the after-treatment begins with the process of gradual further expansion to the end of restoring the right caliber and the wonted suppleness of the urethra. There are, however, cases whose urgency demands still more rapid dilatation during the first sitting. They are those in which retention of the urine already exists and requires immediate relief. It is then necessary to dilate or, perhaps, divulse* the stricture to No. 10 or 12, so as to enable the operator to introduce a catheter of sufficient size to drain (slowly) and cleanse the bladder. Some of those strictures are so narrow as to admit a bougie of only a millimeter or of even less than a millimeter in diameter. In such case a safe method of dilatation is by means of the tunnelled sound for which the bougie (of whalebone) serves as a guide threaded through the short canal at the extremity of the sound. This mode of catheterism upon a con-

*The writer has said next to nothing of divulsion as a primary operation because he has long believed that this divulsing of strictures is, and should be, only the extension of the process of dilatation of dense constrictions which are split longitudinally when a conical sound is wedged in their tract. When bleeding follows the process of rapid dilatation, by a skilled operator, the presumption is strong that longitudinal divulsion has occurred, and the easy passage of a larger instrument may be expected. The writer does not favor the violent modes of divulsion such as those effected by means of the instruments of Holt and others.

ductor, devised in 1864 by the writer, is often the only procedure that can safely be employed for passing eccentric strictures or those complicated with false routes.

13. A method of rapid dilatation of strictures that are not extremely narrow, but that resist the expansive action of bougies or sounds, was suggested by Mercier, and consists in the wedging of an olivary bougie or a conical sound as far as possible in the tract of the constriction, then of passing a slightly smaller bougie or sound, to be followed by a third two sizes larger, and this to be succeeded by a fourth, one size smaller than the last, and continuing the process until the stricture is fairly dilated. The passage of six or eight instruments in rapid succession is often necessary to effect the desired dilatation at the one sitting. Every two or three days thereafter this dilating process is repeated until the constriction becomes tolerant and yields to the action of ordinary dilators. This truly conservative method of treatment has often been the means of avoiding bloody operations. It should, of course, be followed by the periodical use of dilating instruments with the intent of maintaining the established calibration of the urethral canal. It is almost needless to say that an appropriate medical treatment of sufferers from urethral stricture should accompany the surgical treatment. Periodical dilating catheterism is essential to the maintenance of the restored urethral caliber not only after gradual dilatation, but after divulsion and urethrotomy; at first, once a week, then every two weeks, and, finally, every four weeks, for many months or years, according to the character of the original lesion.

14. Unduly frequent and excessive dilatation of the

urethra is an unwise and irrational procedure which has often led not only to loss of the suppleness of the mucous membrane, but to permanent contracture of the whole canal. Such abuse of large sounds being practically the infliction of a series of traumatisms exciting a urethritis whose exudate in the meshes of the ambient connective tissue steadily undergoes sclerous degeneration.

15. Very narrow strictures are now treated differently from what they were even in the last days of James Syme. Whalebone bougies having made it possible, without the use of the knife, to overcome those strictures which were regarded as impassable. Before, however, describing the manner of proceeding in cases of close strictures, particularly the eccentric, the tortuous, and those complicated with false routes, a few words need to be said in regard to what led the writer to employ whalebone instead of other substances as conducting bougies for his conical tunnelled and grooved sounds. At first he had tried for that purpose, Leroy's* gum bougies, but finding them entirely too soft and liable to coil in front of the stricture, he substituted slender shafts of whalebone from half to two-thirds of a millimeter in diameter, twelve inches long and probe pointed. These delicate bougies retain the bend or twist given them when dipped in hot lard oil and suddenly cooled in iced water. The writer is in possession of a set of these instruments which had been so treated twenty years ago and had ever since been in constant use; the elbowed part being in perfect condition for use at the

*Leroy (d'Etiolles). Sur les bougies tortillées et crochues dans les rétrécissements et augusties de l'urètre difficiles à franchir. Paris, 1852.

present time. The tunnelled and grooved sound with a curve equal to one-fifth of the circumference of a circle three inches and a quarter in diameter was devised by the writer in 1864. Its conicity extends from the point up to about five centimeters along the shaft. The smallest sound is registered as No. 2 and is a millimeter and a half at the point, and two millimeters and a half at five centimeters along the shaft; the groove being bridged over at the vesical extremity so as to form a canal or tunnel for the reception of the bougie. The largest of these tunnelled sounds corresponds to No. 15 of the English scale; the groove in all extending from ten to twelve centimeters up the shaft for the lodgement of the bougie. As they increase in size at the shaft, there is a corresponding increase at and from the point, and also an increased tunnel capacity which is very desirable.

16. The way to use these instruments in the catheterism of narrow strictures is as follows: The urethra having been filled with sterilised oil or liquid petrolatum, an elbowed filiform whalebone bougie is slowly introduced to act at first as an explorer in search of the eccentric lumen of the stricture through which, after cautious, gentle, and patient manipulation, it is made to glide its way beyond the constriction. If then arrested in its onward course the presumption is that the point has entered the gaping mouth of an enlarged lacuna, whence it should be gently withdrawn, and by a semi-rotation, the direction of its point changed to be carried in farther. It may then meet with other impediments such as entering the utriculus, one of the ejaculatory ducts, or even the orifice of a ureter, when it is to be governed as already indicated. It is known to have

reached the bladder cavity the moment it can be freely moved to and fro and "no bottom" felt, as in sea sounding. Formerly several straight bougies, five or six, were introduced side by side so that by chance one would enter the stricture, but this mode of proceeding was abandoned after realising the advantages of the elbowed bougie which is used with greater certainty even in the most difficult cases.

17. The next step is the introduction of the sound through whose canal is threaded the bougie to be held by the left thumb and index finger when the sound is slowly slid upon the conducting bougie until its point enters the lumen of the stricture, then without losing hold of the distal end of the bougie, which should be kept in its groove while the sound is passed onward to and into the bladder. A larger instrument is substituted, then a third, and so until the desired degree of dilatation is effected, or the numbers may be gradually increased to the point of divulsion if judged necessary.

18. The divulsion of urethral stenoses is traceable to those early days when an obstacle to the free flow of urine was supposed to be due to the existence of "carnosities" in the canal, and when bougies coated with "escharotic unguents" were used with intent to effect their destruction. When such bougies had passed the obstruction, the consequent permeability of the canal was owing, in all likelihood, to its dilatation or even divulsion. But when metallic instruments were employed for the relief of angustiæ supposed to be caused by "callosities," as in the case of the use, by Francisco Diaz, of his pointed triangular tin sound, divulsion of the really strictured part surely must have occurred.

19. Modern surgeons did not begin to give much thought to any action of instruments upon the stenosed urethra other than its dilatation until Heurteloup had published a method of treatment styled the "modification" of strictures which was supposed to be something like "vital dilatation," but which, on later critical examination, proved to be a divulsion. Amussat, Leroy, Civiale, and others had devised stricture "dilators" which were all divulsors. The few successes that Mayor obtained from what he called forced catheterism of strictures, were doubtless fortuitous divulsions. The "dilators" of Luxmoor, Cooper, Guthrie, Perrève, Michéléna, Rigaud, Holt, and Thompson when expanded to their utmost capacity always caused divulsion of the stricture. Luxmoor's dilator had four blades, that of Cooper two, and Guthrie's three blades. These instruments were all too clumsy and of too large caliber to act upon narrow strictures. Perreve's was the first "dilator" designed (1835) for action upon narrow constrictions. He afterward (1847) adapted to the extremity of this two-bladed instrument a short, slender conducting gum bougie to insure the passage of the "dilator" through very narrow strictures.* Michéléna's "dilator" is described in his thesis on urethral stricture (1847) as consisting of two slender branches free at the vesical end and brought into play by a series of levers moved by a screw at the distal end of the instrument. A similar "dilator" was invented, in 1849, by Rigaud, of Strasbourg; the branches sliding upon each other during their operation, whilst those of Michéléna's preserve their parallelism. The stricture

*Perrève. Traité des rétrécissements de l'urèthre. Paris, 1847.

"dilator" of Bernard Holt, so much used and abused, for a time, in this country, is another of the many instruments devised for effecting what was supposed to be rapid dilatation, but which was afterward acknowledged by Mr. Holt to be a stricture splitter, is now mentioned only in the history of surgical vagaries. The instrument was modified by Richardson, of Dublin, and also by Voillemier, under the name of *divulseur cylindrique*,* tipped with a long, flimsy conducting bougie after the manner of Maisonneuve's *cathétérisme à la suite*.

20. Thompson† described, in 1863, his instrument for gradual distension of the narrowed urethra "at a single sitting beyond the natural caliber of the canal." The two parallel blades to be moved by a lever through screw power at the handle, so that when opened they "form a long oval or spindle-shaped figure"; the widest part to act upon the stricture to be "dilated," and equalling in circumference at least thirty-three millimeters. He afterward acknowledged that, when the branches are fully opened, divulsion really occurs. This "dilator" being of too large caliber for use in very narrow strictures, the writer so modified it as to reduce its size to a millimeter and a half at the vesical end, which is tunnelled so as to admit a small whalebone bougie for conductor; the part to be expanded having a diameter of three millimeters. The branches for five centimeters from the extremity of this curved divulsor are cylindrical and can not pinch or tear the mucous

*Voillemier. Traité des maladies des voies urinaires. Paris, 1868.

†Sir Henry Thompson. Medical Times and Gazette, May 2, 1863.

membrane during withdrawal of the instrument, for they are not to be entirely closed when the operation is accomplished. This or any other branched divulsor should not be used except in cases of emergency when it is absolutely necessary to speedily relieve retention of urine.

21. The idea that the so-called dilators merely stretch the urethra at the seat of stricture is clearly a delusion. In all the cases treated from the time of Perrève's "dilator" to its last modification, bleeding is reported to have occurred in a greater or less degree. Hæmorrhage, under these circumstances, is certainly a fair sign of solution of continuity, of divulsion. The Thompsonian axiom of stretching as much and tearing as little as possible is therefore eminently paradoxical, for, how could the degree of "stretching beyond the natural caliber of the canal" operate otherwise than to tear the walls of that canal often very much too much? Fortunately, the stricture is split longitudinally and the lips of the wound are duly spliced by newly generated tissue coaxed into yielding a wide scar by persistent dilating catheterism as after-treatment.

22. Divulsion of urethral strictures by means of instruments with expanding branches is justified, as already said, solely in urgent cases with threatening complete retention of urine, but is applicable only to those constrictions seated in the scrotal and perineal regions of the urethra. It is contra-indicated in close traumatic strictures, in all strictures complicated with urinary infiltration, and in those of the phallic region.

23. The writer continued to use his own branched divulsor exclusively for some time, after which he em-

ployed it in only exceptional cases and gave his preference to a less sudden divulsion effected by means of conical tunnelled sounds, beginning with the smallest and gradually increasing the size and stopping when No. 8 or 9 of the English scale has been reached. At the next sitting larger sounds without conductor were used to complete the divulsing process. This gradual divulsion has proved very efficient, safe, and successful at his hands. Narrow strictures in the scrotal and perineal regions, even when admitting only filiform bougies, are generally amenable to divulsion with tunnelled sounds, as described and illustrated under the head of retention of urine due to stricture.

24. In the majority of cases, complete divulsion, at one sitting, as a primary operation is not necessary or wise. Divulsion is best and safest when it is the extension of dilatation carried out by conical instruments; the proof of its attainment being the slight hæmorrhage following the withdrawal of the sound last used. This mode of proceeding was adopted by the writer after he had witnessed the ill effects of the sudden violence inflicted by Holt's method of using his "dilator."

25. Surgeons have long entertained the correct idea that there is no method of treating urethral stricture that does not require the periodical use of dilators for a long time after the stricture has seemed to be cured; gradual dilatation, divulsion, and internal and external incisions, being only means to the desired end which is the restoration of the normal caliber and suppleness of the urethra.

VIII

URETHRAL STRICTURES IN THE BALANIC AND PHALLIC REGIONS; THEIR INCISION

1. Stenoses at the external urethral orifice and in the fossa navicularis are of much more common occurrence than generally admitted by some early writers on urinary affections. Many of these stenoses are congenital, a lesser number traumatic, still fewer are chancrous, but the vast majorities are owing to neglected urethritis. They occur in the proportion of at least thirty per cent. of all urethral strictures.

2. The congenital stenoses are ordinarily confined to the meatus, but sometimes involve the whole fossa navicularis. In certain cases the lower wall of the navicular fossa is wanting and the narrow urethral opening is seated at the base of the glans penis and takes the form of a transverse or of a crescentic slit; this being a true balanic hypospadias. Then again the narrow meatus appears almost on the top of the glans; constituting the first degree of balanic epispadias. In other cases there is, at a short distance within the meatus a valvular fold of mucous membrane, or a thin septum with central or eccentric orifice; but generally it is the normally situated meatus which is abnormally narrow, and this is often associated with congenital phimosis; the preputial orifice occasionally being so extremely narrow as barely to admit the passage of the smallest probe. The very

rare occurrence of congenital imperforation of the meatus should be looked for and at once relieved as soon as it is found that the new-born infant has not urinated.

3. Traumatic stenoses result from several different kinds of injuries. A common cause is the unduly frequent, careless, or violent catheterism, wherein the parts are bruised and become inflamed, constricted and sometimes so hard as to simulate cancerous degeneration. Accidental transverse wounds through the glans penis however promptly they may heal end in stricture of the fossa navicularis. Extirpation of the glans without special care to form an ample urethral orifice is certain to cause stenosis of the new meatus. Another accident causing stricture at the extremity of the urethra is the slicing of the end of the glans during circumcision of infants.

4. Chancrous stenoses are due to the cicatrisation of chancrous or of chancroidal sores which so often sweep away the extremity of the glans penis and extend to a greater or less depth in the fossa navicularis.

5. Stenoses due to neglected urethritis may be seated at either end of the navicular fossa; more commonly, however, at two or three millimeters back of the external orifice, and sometimes attended with erosion of its lips or with induration of the whole balanic region.

6. Strictures in the balanic region, except when very narrow, seldom attract the attention of those so affected, and even then cause no apprehension unless the arrest of a calculus or some other accident interferes with urination. It often happens that the congenitally narrow meatus is not discovered until, in advanced life, the patient seeks relief from retention of urine due to

prostatic obstruction or to a deep-seated urethral stricture. It should be borne in mind that the normal meatus is the narrowest and least extensible part of the canal; bearing the same relation to the urethra that the nozzle does to the pipe designed to propel a stream of water.

7. The immediate effect of stenosis of the balanic region, in the great majority of cases, besides the ever-occurring dysuria, is a localised granular urethritis, even in those instances where urethritis was not the cause of the coarctation. This granular urethritis is manifested by a slight gleety discharge which glues the lips of the meatus, and, for a moment, checks the stream of urine. It is partly on account of the gleet that patients seek advice. The physician then soon satisfies himself of the existence of a stricture at the meatus by ocular inspection or, when the constriction is in the navicular fossa, by the aid of the acorn-tipped bougie; no other instrument being of any avail for such diagnosis.

8. The remote effects of long neglected balanic stenoses are: expansion of the canal behind the obstacle to urination; ulceration or even rupture of that part of the canal followed by extravasation of urine; and fatal lesions of the bladder, ureters, and kidneys. The writer was once called to see a moribund patient who soon died from the effects of a chancrous stricture, of long standing, at the end of the urethra which barely admitted a small probe; infiltration of urine having already occurred, and the upper urinary organs being hopelessly involved. Civiale recorded three cases of balanic stricture where the urethra had burst behind the glans penis and the urine

had infiltered the tissues as far as the scrotal junction. In one of these cases there ensued many small urinary fistulous tracts behind the glans. Many more examples might have been given to show that neglected balanic constrictions are as liable as those deeper seated in the urethral canal to cause serious local damage besides structural alterations of the upper urinary organs that are beyond remedy.

9. Stenoses of the external orifice and of other parts of the balanic region are generally so refractory to dilatation as to require free division, except those very thin crescentic or bridiform folds which are so often destroyed by the passage of a full-sized sound.

10. Incision of the meatus, which is properly styled urethral porotomy, was resorted to, in 1824, by Civiale to permit the passage of those large calibered instruments which he used with such masterly skill in the operation of lithrotrity. Afterward he found it necessary to enlarge by incision the end of the urethral canal in order to carry out the process of gradual dilatation of strictures in the phallic and perineal regions or simply to cure those of the balanic region. For this purpose he devised a little porotome which he named *bistouri caché*. The operation is, however, as well accomplished with a blunt pointed narrow straight bistoury. Incision of strictures at the meatus and in the navicular fossa was practised by Horner and by Ashmead, of Philadelphia, quite as early as, and perhaps earlier than, the eminent French specialist.

11. In the early times of urethra cutting, the incisions designed to free the balanic and other regions of the canal were very little more than scarifications of no

value as curative means, and it was not until after the publication of Reybard's work on stricture that surgeons realised the importance of making more liberal cuts to insure the patency of the balanic and other regions. In the case of balanic hypospadias with a very small transverse or crescentic orifice at the base of the glans, the abnormal outlet is enlarged by means of a bi-lateral porotomy as first suggested by Payan. When, in the new-born infant, retention of urine is found to be due to an imperforate meatus, the occluding thin membrane is pricked with the point of a sharp, narrow instrument of any sort which will make a sufficient outlet for the retained urine.

12. The after-treatment of porotomy consists in the insertion of a small pledget of gauze between the lips of the wound to check the slight bleeding and to prevent immediate union of the incised parts. This pledget to be renewed when washed away by the stream of urine, and retained, if possible, for twenty-four hours, after which a full-sized sound is introduced every second day until the wound shall have healed, and then every third or fourth day for five or six weeks.

13. During the last third of the nineteenth century urethral porotomy was very much overdone, even to the extent of causing unsightly and injurious hypospadias. The realisation of the ill effects of excessive meatus cutting having led surgeons to a rational conservatism, these too free incisions are no longer practised. A moderately free porotomy is now regarded as sufficient for the successful treatment of narrow balanic strictures and for such congenital stenoses as may interfere with the passage of the full-sized sounds

used in dilating deep seated constrictions, or with the introduction of instruments applied to the destruction of vesical stones.

14. Grave are sometimes the consequences of traumatic strictures of the end of the urethra, particularly when, after amputation of the penis, precautions are not taken in the formation of an ample artificial meatus. The writer remembers well a wretched sufferer, from this cause, whom he had watched during hospital interneship. The man's penis had been amputated on account of some suspicious ulcerated warty excressences closely resembling epitheliomata. A few months after the operation the end of the urethra was so much contracted as greatly to impede urination. For several years he had spent much of his time in vain efforts to empty his bladder; suffering much pain at each urination, and finally succumbing from cystitis and pyelonephritis. Several other cases of the same sort afterward attracted the writer's attention and led him to inquire into the history of penis amputations and of means employed to prevent the sad consequences of neglect of the stump. He then learned that divers surgeons had striven to guard against the occurrence of stenosis at the urethral extremity by cutting the cavernous bodies in wedge form and severing the urethra transversely at about two centimeters anterior to the cut end of the cavernous bodies, then slitting it along its floor and everting and stitching it to the end of the stump, thus forming a sort of glans with a wide meatus. Sometimes three urethral flaps were made and stitched as in the first instance. In those cases where the penis was amputated close to the pubes, the scrotum was

bisected so that each testicle was enclosed in a separate scrotum, the cut edges of which were sutured; the urethral extremity being fastened at the commissure of the bifid scrotum. This mode of operating was resorted to at the St. Eloi Hospital, Montpellier, by Delpech, in 1832; by Lallemand, in 1844; and by Bouisson, in 1855; with excellent results. In cases of atresia of the urethral end after amputation of the penis, it has been found necessary to open the urethra in the perinæum to insure free urination. Such an operation was performed by Erichsen, of London, in 1857; by Johnston, of Baltimore, in 1877; and twice by the writer, in 1877; stitching the edges of the slit urethra to those of the perineal wound. In 1854, Demarquay excised the entire penis including the crura, for epithelioma, and attached the slit urethra to the edges of the wound in the perinæum, thus making a sort of vulva. The writer had occasion to repeat Demarquay's operation and obtained the same gratifying result.

15. Stenoses of the phallic region will be here considered chiefly in relation to indications and modes of treatment, and to the development and improvement of needed instruments. The knowledge gathered from study of their pathogeny, during the past forty years, has led modern surgeons to the conclusion that only those constrictions of this region which are absolutely refractory to dilatation warrant internal incision, and that those seated in the perineal region are best treated by external division. Whilst the internal operation is the easier, the external perineal has the important advantage of being exempt from the main accidents of the internal perineal operation.

16. The end sought in the performance of internal as well as of external stenosiotomy and in subsequent periodical dilatation of the canal, is to secure the formation of a wide and pliable cicatricial splice between the lips of the newly made incision, and thus to re-establish as nearly as possible the normal caliber and suppleness of the urethra.

17. The destruction of imaginary urethral "carnosities" by an internal operation is traceable to Ambroise Paré, who was wont to scrape, tear, or pinch off these "carnosities" through the means of a fenestrated canula or catheter. This seems to have been the first endeavor to render the obstructed urethra patent by a radical operation. Paré's proceeding apparently suggested to Francisco Diaz the devisal, in 1576, of a curved instrument to puncture "carnosities" or otherwise effect the liberation of the urethral canal. From that time nothing of striking interest appears in the history of internal operations upon the urethra until the year 1813, when Dorsey gave the account of an instrument, invented and used by Physic, of Philadelphia, in 1795, styled the lanceted stilette, for puncturing or perforating urethral strictures. Similar instruments were devised by McGhie, in 1823, and Stafford, in 1827. It is scarcely necessary to say how wrong they all were in mechanical principle, how ineffective for good and how dangerous in practice.

18. In 1824, Amussat presented to the Academy of Medicine an instrument for dividing bridiform strictures, and also two urethral scarificators which were practically reproductions of long rejected instruments. Soon after this appeared many stenosiotomes of sundry varie-

ties of forms, bearing the names of Civiale, Leroy, Ricord, and other specialists. These primitive contrivances effected nothing but the merest scratches of the urethral mucous membrane but continued to be used, at the suggestion of Leroy, in combination with cauterisation. The results of this double procedure were very far from being satisfactory.

19. Reybard, of Lyons, then produced a new urethrotome having a short, slender whalebone tip to act as conductor through the stricture. That instrument was armed with two concealed blades to be thrust out after the passage of the shaft beyond the constriction which was to be freely divided from behind forward. The innovation caused the abandonment of the practice of urethral scarification as a means of cure. Reybard, not entirely satisfied with his own urethrotome, modified it variously from 1839 to 1847. The last modification enabled him to cut through the entire thickness of the urethra, a process which he believed to be essential to the cure of coarctations. An eye-witness to one of his operations in the phallic region reported that the blade of the urethrotome was seen to pierce the skin. The winner of the Argenteuil prize was not content with deep cuts only but regarded length as necessary to the ultimate object of his operative process and made incisions as long as seven centimeters. Profuse hæmorrhage, infiltration of urine in the perinæum and scrotum, abscesses, and other serious lesions were the immediate effects of many of that enthusiast's operations with his "*urêthrotome dilatateur.*" One of the remote effects in some of the cases declared cured was recontraction of the stricture said by the operator to be impossible.

Further observations and experiences with "dilating urethrotomy," caused it to be regarded as a delusion and a snare; the "dilating" urethrotomes doing either too little or entirely too much toward stenosiotomy, for when the "dilating" part of the instrument was brought into full play divulsion really occurred and therefore there was no necessity to incise, and when the blades were protruded from the shaft of the instrument the depth and length of the prescribed cut were indeed fraught with all the sad consequences foreseen and witnessed by impartial observers.

20. The surgeons who had voted in favor of the award, in 1852, of the Argenteuil prize to Reybard were the first to condemn the practice of his very deep and long incisions; declaring that they had signed the report not because of approval of the heroic method, but on account of the excellent studies and original ideas of the candidate's essay.

21. Maisonneuve, realising the difficulties often arising in the preliminary catheterism necessary to urethrotomy from behind forward, devised, in 1855, a urethrotome for division of narrow strictures from before backward. Instead of having recourse to a metallic conductor, as had done, for the purpose, Jameson, of Baltimore, in 1827, he used as a guide a filiform gum bougie to be screwed to the end of a slender metallic shaft grooved to receive a rod which carried a triangular blade blunted at its apex. This urethrotome was modified by Voillemier, who placed beside the sharp, triangular blade a blunt shield of the same form for protection of the anterior urethra during the passage of the instrument to the stricture, in imitation of Jameson's urethrotome.

These instruments for anterograde urethrotomy, still much used, are objectionable in several particulars, not the least of which is the liability to accidental section of the bougie which had not completely passed and lay coiled in the urethra in front of the stricture, or if it had passed beyond the obstacle might be lost in the bladder. Another objection is that the guide bougie is liable to double up in front of the stricture instead of entering its lumen, and even when passed successfully it may still bend (this has occurred) when the instrument is pushed in, and thus lead the metallic conductor astray in the tissues through a false route which it has made, so that other parts than the stricture are cut by the wandering blade. The advent of Maisonneuve's mode of operating caused the invention of several urethrotomes intended to cut from before backward and then from behind forward, such are those of Ricord, Trélat, and Charrière.

22. Civiale, who was never an advocate of anterograde stenosiotomy, had, as early as 1849, devised a very simple urethrotome for the retrograde operation. It is perhaps the best and safest of all the stenosiotomes in use up to the present time. He was no partisan of the internal division of strictures seated in the perineal region, and his stenosiotome was designed to act upon those of the phallic region, which required very little preliminary dilatation. The instrument is also an explorer with a flattened bulb, of scarcely three millimeters in mean diameter, containing the blade which is brought into basculation by a very simple mechanism.

23. To enumerate and describe the many scores of urethrotomes invented during the nineteenth century

would fill a large volume, so this brief sketch of the history of urethrotomes and of internal urethrotomy must here end.

24. Internal stenosiotomy in the perineal region was very commonly performed during the second half of the nineteenth century and is even now too often done where it is so clearly contra-indicated owing chiefly to the danger of urinary infiltration, abscess formation, and other untoward results. Assuredly the external operation is a far preferable and safer process in the vast majorities of constrictions of that region of the urethra.

25. Internal stenosiotomy from before backward in the phallic region is justifiable only in cases of very narrow constrictions that are refractory to dilatation, especially those that threaten retention of urine. In such cases the safest way to accomplish the section of the stricture is first to pass in a filiform whalebone bougie to be followed by a very small tunnelled urethrotome which will cut sufficiently to permit the entrance of the smallest of Civiale's retrograde urethrotomes and so complete the operation under cocaine local anæsthesia. However, the first cut may safely be made with a long probe-like narrow-bladed, round-pointed, straight bistoury.

26. Internal stenosiotomy from behind forward, in the phallic region, often requires a little preliminary dilatation either gradual or continuous when narrow refractory strictures are not complicated with retention of urine. In favorable circumstances, immediately after sufficient dilatation, the smallest retrograde urethrotome is passed through, the blade basculated and the constriction, with a little uncontracted urethra in front

and behind, is slowly and gently incised by drawing forward the instrument and carefully resheathing its blade before it is withdrawn. The after-treatment should consist in passing into the bladder a soft rubber catheter to be retained in position for twenty-four hours, during which time no urine should be allowed exit except through the catheter. After this a full sized sound should be introduced, and immediately withdrawn, every second day for two weeks, then once each week for three months, and finally once monthly for as long a time as may be needed to prevent recontraction which is certain to occur from neglect of systematic persistent catheterism.

27. The urethra-cutting rage of the last century requires a few closing words for the particular benefit of beginners.

28. The many monographs on stricture, published from 1840 to 1870, especially those of the great Scotch surgeon James Syme, seem to have given rise, among young operators, to the stricture-cutting mania, with attendant delirium of numbers, which was so prevalent for about twenty years, but which, fortunately, lessened in intensity, until even the tyros in surgery ceased boasting of their annual hundred urethrotomies. This urethra-cutting madness had led also to division of the meatus to the point of hypospadias for the purpose of frequently and excessively distending, with enormous sounds, the whole urethra, which soon lost its suppleness and at length became indurated and leathery; subserving no better purpose than that of an unyielding canal remindful of a decayed India rubber tube. These extreme measures were at last forsworn because experience

proved them to be worse than useless and also because of a better knowledge of the minute anatomy of the urethra and of the nature of its morbid states. It was the apparently slow process of dilatation as well as the common report of failure of other modes of treatment that had led heroic beginners to indiscriminate and unduly frequent urethra-cutting, and it was not until they had learned how little, if any, time was to be gained through a bloody procedure and had felt the absolute necessity of using dilators as the after-treatment for many months following the incisive operation, that they strove to reinstate the too much neglected simple process of dilatation so well suited to the majority of cases. They had then realised that no single method of treatment was applicable to all cases, and furthermore, that the decision of the important question of indication of a particular method must be based upon mature experience and sound judgment.

IX

URETHRAL STRICTURES IN THE PERINEAL REGION; THEIR EXTERNAL DIVISION

1. The external incision of narrow urethral strictures in the perineal region has long been in use under the divers designations of puncture of the perinæum, *boutonnière*, perineal section, perineal urethrotomy, and external urethrotomy. For the relief of retention of urine and also to make a route to the bladder for the extraction of stones, the eminent French surgeon Foubert was bold enough to plunge a bistoury into the perinæum without any guide whatsoever until it reached the bladder. This may possibly account for the term "puncture of the perinæum," but certain surgeons did actually use trocars for puncturing the urethra through the perinæum in order to give issue to urine retained in the bladder, and later surgeons have used the expression "tapping the urethra,"* which was done with a sharp knife in imitation of Foubert's method. The writer prefers to designate the operation as external perineal urethrotomy, or, to be more exact, external perineal urethro-stenosiotomy, because *boutonnière* conveys no other meaning than a button-hole, because a perineal section may be made for some purpose other than to divide the urethra, because perineal urethrotomy may

*Edward Cock, of London, in 1866, described his method of "tapping the urethra at the apex of the prostate."

be internal, and because external urethrotomy does not necessarily mean that it is performed in the perineal region, or that it is with intent to divide a strictured urethra.

2. The beginning of the practice of laying open the perineal region of the urethra for stone extraction and for other purposes is lost in the mists of surgical antiquity. The earliest record of the employment of a perineal cut for the relief of urinary retention, has been traced only to the tenth century, when Rhazes is said to have made, for this purpose, a small incision of the urethra through the perinæum. Avicenna, who lived in the eleventh century, is quoted as saying substantially that "there are some who have taken another route; they have made a small incision, between the anus and the testicles, into which a canula was introduced to give issue to the urine." Such evidently was the customary practice in the time of Avicenna.

3. Nothing more on this subject appears in ancient surgical literature down to the sixteenth century when John of the Romans invented the "greater apparatus" of lithotomy, the first step of which was to open the urethral canal through the perinæum to the left of the median line.

4. The first recorded case of external urethrotomy for the cure of stricture appears in the eighth book of the "Chirurgical Treatises" of Richard Wiseman, who said that, in the year. 1652, he had assisted Ed. Molins in operating upon "an old fornicator who had long been diseased with a carnosity which had resisted all endeavours and in a manner totally supprest his urine." The urethral canal was cut open behind the point of ob-

struction and kept patent, for a time, by the passage of small bougies, but the wound closing, and difficult urination recurring, the sufferer urged a second operation which involved the scrotal and perineal regions of the strictured urethra. The wound was stitched and healed in a few days except at a small point which became the orifice of a urinary fistula.

5. Solingen is quoted by Stalpart Van der Wiel as undertaking this operation at Livourne and at the Hague. The second was upon a sailor whose urethra was laid open from the base of the glans penis to the perinæum with the object of cauterising "carnosities," and closed the extensive wound with twisted sutures. This inordinate urethrotomy with urethroraphy has been practised by other surgeons down to near the close of the nineteenth century, generally without success, and only serves to show how unwarrantable are incisions involving the phallic region of the urethra.

6. The eminent lithotomist François Tolet performed "puncture of the perinæum" during the seventeenth century, saying: "If the parts surrounding the urethra have become callous and so hard that by compression they have caused an angustia whence arises difficulty or suppression of urine, a fusiform hardness is felt extending from the perinæum toward the neck of the bladder. To cure this callosity, after having made upon a grooved staff an incision as if for the extraction of a large stone, it was necessary during the first few days to pass a canula. . . ." This seems to have been the first instance of urethro-coarctotomy upon a conductor.

7. The chief lithotomist of his time, François Colot, is said to have operated, in 1687, for a narrow urethral

stricture by a method "never before used"; his design being to "make a perineal incision without guide and without opening the urethra; wishing to excite suppuration and relax the parts so as soon to be able to introduce a catheter." This seems to have been successful, and in a short time twenty-four small calculi escaped with the urine passed by the natural route.

8. In those cases of "carnosities" that proved refractory to leaden sounds and were complicated with infiltration of urine or with fistulæ, Palfin recommended a mode of external division which he had witnessed in the practice of Colot; saying that, instead of medicated bougies Colot made a cut, in the perinæum, a little shorter than that for the extraction of a stone.

9. In cases of retention of urine, Dionis, like Foubert, advised "puncture of the prinæum" by plunging, in the median raphé, a narrow bistoury four or five inches long until it reached the bladder; this being followed by the introduction of a canula to be secured in position after the escape of the urine. Such was also the method employed by Thévenin.

10. In his annotations to Dionis' surgical work, De la Faye suggested the incision of angustiæ of the perineal region upon a grooved staff whenever such could be passed, and, when no staff could be introduced, advocated puncture of the urethra with a trocar in order to relieve the bladder of its urinous burden. Jean Louis Petit and Morand also had had recourse to the guidance of the grooved staff, and had used the trocar in cases of impassable strictures.

11. Ledran, in 1730, operated, in three sittings, for impassable stricture complicated with thirty fistulæ

and great induration of the scrotum and perinæum. It was only at the third sitting, five days after the first, that he succeeded in finding and dividing the stricture and reaching the bladder, into which he introduced a leaden canula that was retained in position for three weeks. The patient made a good recovery despite the long retention of the canula, and was advised to use bougies periodically to prevent recontraction of the urethra.

12. Petit was a very strong advocate of external incision of the urethra in perinæo; insisting that complete longitudinal division of the stricture be made at the same time, especially in cases complicated with fistulæ or with retention of urine. This external operation had also among its other advocates Lassus, Col de Vilars, and Astruc, all of whom used the trocar whenever the stricture could not be passed; particularly in the emergency of complete retention of urine.

13. Perineal puncture with trocar or bistoury found a determined opponent in the noted English surgeon Samuel Sharpe (1782), who regarded supra-pubic puncture of the bladder, for the relief of retention of urine, as a much safer and better procedure than the perineal operation.

14. In the latter part of the year 1783, John Hunter had occasion to treat an impassable stricture with a fistula in the perineal region. He began by passing a grooved staff down to the stricture in front of which he opened the urethra. Finding the orifice of the constriction, he did not cut but dilated it slightly, and with some difficulty passed into the bladder a small catheter, which was retained in position for two months, when it

was withdrawn because it had evidently retarded the healing of the wound which then "took on a more favourable aspect," and in two weeks thereafter was entirely closed; urination being normal and in full stream. The management of this case was somewhat after the manner of Colot, who, however, did not open the urethra in the case he detailed in 1687.

15. For impassable stricture, Hunter proposed another operation which, despite his great authority, fortunately has had but few advocates. The description, here given, of the procedure, is in his own language, and is as follows: "Where this operation is performed in consequence of a stricture, I have conceived that by passing a catheter into the urethra from the bladder till it comes to the stricture, and then passing another straight canula from the glans down the urethra, that the two may nearly meet, only leaving the stricture between them; and a piercer may be passed down and forced into the end of the one from the bladder, and afterwards either a bougie or a hollow catheter introduced." Little need be said of the uncertain route the "piercer" may take in such a case, or of the uselessness if not the danger of the proceeding as compared to a simple incision of the hardened tissues surrounding the stricture and of the stricture itself.

16. This short outline of the early history of external perineal urethrotomy brings it down to the end of the eighteenth century, when its mortality was such as to lead to the general condemnation of the operation, that it fell into desuetude. It was, however, revived in this country by Alexander H. Stevens, who, in 1817, incised a urethral stricture in perinæo "with entire success,

after the common modes of treatment had failed." The operation was performed many times from 1820 to 1843 by other American surgeons, among whom were Jameson, Rogers, Warren, Hoffman, March, Post, Watson and Buck.

17. In these and all subsequent operations without conductor, the rule, established by Petit, of completely dividing the strictured part of the urethra, was followed almost invariably. The incisions were no longer extended to the bladder but restricted to the perineal urethra in the median line; the canal being laid open longitudinally upon a grooved staff in front of the stricture, into whose lumen a small grooved probe, as suggested by James M. Arnott, was then inserted and the whole constriction clean cut lengthwise by means of a slender bistoury slid along the groove of the probe.

18. The main improvements in this operation as performed during the first half of the nineteenth century were due chiefly to Arnott and Guthrie, and the mode of proceeding was styled "perineal section," which was a urethrotomy without conductor; that is to say, without the passage of an instrument through the stricture before cutting the perineal integuments. This operation without conductor is now justifiable only in cases of stricture impassable by the smallest bougies, particularly when attended with retention of urine.

19. External perineal urethrotomy with a conductor, as practised by Tolet and also by De la Faye, seems to have been forgotten until 1840, when James Syme adopted it in a case of resilient stricture where both dilatation and internal urethrotomy had failed. The eminent Scotch surgeon afterward made some improve-

ments in the method and in the needed instruments, especially in the case of the well known combination of grooved staff and conductor into a single metallic instrument. In the operation he followed strictly Civiale's excellent rule of incising the urethra not less than a centimeter in front and behind the stricture. Such was Syme's "perineal urethrotomy," which in his deft hands was so brilliantly executed and which was employed so successfully by many other surgeons. However, the introduction of his metallic guide-staff is not always easy, and its point may enter, and has entered, a false passage, and thus defeated the object of the operation, namely, the division of the stricture. This accident was once witnessed by the writer during a "perineal urethrotomy" performed by a skilful surgeon. The patient died a few days after the operation. On post-mortem examination of the parts it was ascertained that the stricture had not been cut and that a long false route had been incised in its stead. Principally on account of the liability of "perineal urethrotomy" to such accidents when Syme's staff is used, the writer strove to devise a method of operating for narrow strictures by which like untoward happenings may be avoided. The steps of the operation, the first of which he performed on the 27th of January, 1869,* are as follows:

20. The perinæum having been shaved and washed the patient is rendered insensible to pain and is placed in the lithotomy position. The urethra is then cleansed

*It was in 1865 that the writer began to use filiform whalebone bougies as conductors in the operation of external urethrotomy, but the idea of the tunnelled and grooved catheter staff did not occur to him until 1868, and the instrument was not made until the end of that year.

and explored to ascertain the exact site of the stricture. After this the canal is filled with oil or liquid petrolatum, and a capillary probe-pointed whalebone bougie introduced. If its point becomes engaged in a lacuna, it is drawn out of the lacuna and carried onward with a rotary movement. If it happens to enter a false passage it is retained in situ while another is passed by its side. If this second guide bougie makes its way into the false passage, it is to be treated precisely as was the first, and the operation repeated till one guide passes into the lumen of the stricture and enters the bladder. Sometimes five or six guides are thus caught before the false passage is filled up and the natural route found. In this manner the bladder is frequently reached in very narrow strictures supposed impassable, and after all other means had failed. As soon as a guide enters the bladder—as indicated by the ease with which the instrument is moved to and fro—the other guides are withdrawn. Another way of avoiding a false route or of finding the eccentric lumen of a stricture, is by the use of the elbowed filiform bougie which is an excellent explorer and path-finder.

21. The next step is to introduce a No. 8 grooved metallic catheter with a centimeter of its extremity bridged over so as to convert the groove into a canal; the bridge itself being also grooved. Its introduction is accomplished by passing through the canal or tunnel the free end of the retained guide bougie; holding it steadily between the thumb and index finger of the left hand, and pushing the catheter staff gently into the urethra until its point comes in contact with the face of the stricture. The staff and guide are then kept in position

by an assistant, who at the same time supports the scrotum; the patient having already been secured in the lithotomy position.

22. The surgeon, seated on a low chair, first makes a digital exploration per rectum, to ascertain, in a measure, the condition of the membranous and prostatic divisions of the urethra; then he makes a free incision, in the median line of the perinæum, extending from the base of the scrotum to about a centimeter from the anal margin, involving only the skin and superficial fascia. The incision ordinarily made in this operation is from three to four centimeters in length, but it is obvious that the freer incisions possess the advantage of better exposing to view the underlying parts, while they tend to prevent infiltration of urine in the superficial layers. A few well directed cuts having brought to view the urethra, the operator, with his finger-nail, feels for the groove on the bridged portion of the staff and cuts open the canal, upon this groove, longitudinally in the median line, exposing to sight the end of the staff. A loop of silk is then passed through each edge of the incised urethra, close to the face of the stricture, and held by the assistant in charge of the corresponding limb. This excellent contrivance, of the London surgeon Avery, is of the greatest service, as it constantly keeps in view the median line. The urethra having been opened and the loops of silk securely held, the catheter is pulled forward just enough to bring into view the black guide and permit the passage, along this guide, of a probe-like very small beaked bistoury, with which to divide the stricture and about one centimeter of the uncontracted urethra behind; the edge of the

instrument being directed downward. The last step is the passing into the bladder of the catheter-staff, guided by the whalebone bougie; but should it be arrested in its course by a second stricture, the beaked bistoury is again introduced and this second stricture divided. The operation is thus completed without further delay, the bladder is entered with the greatest gentleness, and the free flow of urine through the catheter makes it certain that the stricture has been divided and not a false passage.

23. This method of treatment is particularly well adapted to cases in which there is great induration or tumefaction of the perinæum from long standing trouble or from extravasation of urine. The presence, in the bladder, of the whalebone guide so firm though delicate; the assured position of the tunnelled catheter-staff compelled to follow the guide which lies in its terminal canal; the light thrown into the wound through the agency of the loops of silk which so constantly indicate the situation of the urethra and of the median line; the ease and certainty with which the catheter-staff, still sliding over the guide, is made to enter the bladder after incision of the stricture; surely contribute largely to the success of the operation. When the initial passage of the whalebone guide cannot be effected, it may be introduced by way of a cut made into the urethra beyond the stricture through which it is passed from behind to serve as a conductor for the beaked bistoury; or Arnott's grooved probe may be used as a guide for the incision of the constriction. In either case, with the guide in the bladder after the incision, the point of the catheter-staff may be protruded from the wound, the free end of the

guide carried through the terminal canal, and the bladder entered as before described.

24. Whenever the physical condition of the patient is such that the operation can be safely postponed, which may be done when there is not retention or extravasation of urine, it is wise to place him, for a few days, under the following course of preparatory treatment:

25. The sufferer is confined, as much as possible, to the recumbent posture, and is given a warm hip-bath every night; five minims of tincture of iron chlorid thrice daily, and five grains of quinine at bed-time; diluent drinks, etc. To allay spasm and procure sleep, a rectal suppository containing one grain of aqueous extract of opium and half a grain of belladonna extract is to be used every night. Twenty-four hours before the operation one ounce of castor oil should be administered, and on the morning of the operation, an enema should be used to completely cleanse the rectum.

26. After the operation, and prior to the patient's complete recovery from the effects of the anæsthetic agent, ten grains of quinine together with a quarter of a grain of morphia should be administered; and as soon as practicable a broth should be given. On the following day the diluent drinks and the iron are resumed, with the addition of three grains of quinine three times daily, to be continued for two or three weeks. A warm hip-bath should be taken nightly as soon as it is safe for the patient to rise from his bed.

27. Such a course of treatment is likely to prevent some of the unfavorable happenings which are sometimes consecutive to the operation. The surgical after-treat-

ment is at first similar to that observed in lithotomy. The scrotum is supported by a suspensory bandage to guard against the possibility of infiltration of urine into its connective tissue, and the patient is kept on his back. Generally, the first time he urinates, the greater part of the urine flows through the perineal wound, but afterward, for about forty-eight hours, all the urine is discharged through the whole length of the canal owing to the temporary swelling and contact of the lips of the wound. As soon as this swelling subsides, a certain quantity of urine again passes through the perineal wound.

28. In the great majority of his operations, both of internal and external urethrotomy, the writer has not followed the usual practice of tying in a catheter. The wound is not disturbed, and no instrument is passed into the urethra or bladder until the second or third day, when a full-sized conical steel sound is introduced, and the process repeated every third day until the wound is healed, and then the patient is taught to pass the instrument and advised to continue its use indefinitely.

29. The alleged reasons for tying in a catheter and retaining it in position often for several weeks, are: first, to prevent the urine from coming in contact with the freshly cut surface; and second, to hasten union by still endeavoring to prevent the urine from passing through the granulating wound. That a catheter tied in that position does not prevent the urine from escaping between it and the urethral walls, however large the instrument may be, has long since been demonstrated, and there are few surgeons who have not verified this fact. That the presence of the catheter does not has-

ten, but on the contrary, does retard the progress of union of the wound, is well illustrated by many published cases.

30. In the performance of external perineal urethrotomy it is wise to adhere to the rules, given by Syme, to be observed in the operation of "external urethrotomy," with the exceptions mentioned below. These rules are: 1. Maintain the median line in the incisions; 2. Make a direct opening down to the staff, not a tortuous one; 3. Divide the whole of the contracted part, rather more than less; 4. Do not cut so far back as to endanger the deep fascia of the perinæum, and use the knife in the deep incisions with the cutting edge uppermost; 5. Do not close the end of the inlying catheter, lest urine be forced into or through the wound for want of patency in the instrument; 6. Avoid escape or displacement of the instrument; 7. If incisions are made far back, introduce the curved tube through the wound when the catheter is withdrawn; 8. Do not neglect dilatation during the progress of recovery.

31. The fourth rule is departed from in cases of stricture seated at the bulbo-membranous junction for the simple reason that the free division of such a stricture involves at least the anterior layer of the triangular ligament, without serious harm. As to the direction of the knife's edge, the careful operator may turn it up or down with equal safety.

32. The fifth, sixth, and seventh rules may well be departed from, insomuch as the retention of a catheter in the bladder, after this operation, even for forty-eight hours, is not only unnecessary but harmful. Unnecessary, because it does not fulfil the indication of pre-

venting the flow of urine through the wound, and because the contact of urine with the freshly-cut surfaces does no harm, as exemplified by perineal lithotomy; harmful, because the presence of the instrument in the bladder sometimes causes ulceration and perforation of that viscus, and does give rise to urethral fever. It is well known that however large may be the caliber of the retained catheter, a certain quantity of urine always flows between it and the urethra, as testified by Vidal and others, among whom was Thompson, who, in speaking of the treatment of obstinate urinary fistulæ, said: "Experience shows that, however large the instrument may be, and however closely it may fit the urethra at the present moment, before twenty-four or thirty-six hours have elapsed, it will lie loosely in the canal, and urine will pass by its side. . . ." He further said that "the mode of treatment, therefore, which consists of tying in a catheter, is to be regarded as inadequate to the cure of fistula, except so far as it produces dilatation; and it is one which has obtained countenance chiefly from the plausibility of a theory which is certainly unsupported in practice."

33. Syme, in referring to between eighty and ninety "cases of external division of the urethra," said: "Alarming symptoms were by no means rare, since every third or fourth patient suffered from rigors, vomiting, delirium, or suppression of urine." The presence of the catheter doubtless was the exciting cause of these grave phenomena. After having treated this number of patients without a death, he met with two fatal cases which he attributed to contact of the urine with the wound, and then proposed the use of a short catheter

to be introduced by way of the perineal wound and secured in position. This, though not so harmful, is quite as unnecessary as the use of the long catheter. A physician of New York related the history of a patient upon whom the "perineal section" had been performed and where ulceration had taken place at the peno-scrotal junction of the urethra from the prolonged retention of a silver catheter, so that the instrument could be seen through the fistulous opening which showed no disposition to heal. Bumstead mentioned one instance of death occurring from retention of the catheter for a fortnight, "and at the post-mortem examination there was found a small, but deep, ulceration of the bladder, and another, quite extensive, of the inferior wall of the urethra in front of the scrotum, which was only separated from the surface by the integument." A fatal case occurred in the practice of Professor Spence, of Edinburgh, where "peritonitis was excited by the penetration of the coats of the bladder by the in-lying catheter." The retention of a catheter, for forty-eight hours, in some of the writer's early cases, caused cystitis and urethral fever. In one case, recurring chills during four days, compelled the withdrawal of the instrument when they ceased. A second operation being required in this same case, no catheter was tied in and the patient escaped urethral fever and made a good recovery.

34. From the foregoing abundant testimony it is fair to conclude that the retention of a catheter in the bladder passed either through the whole length of the urethra or through the perineal wound, does not fulfil the indications for which it is used; that it is, as a general rule, attended with danger; and that its omission is a safe

measure. In certain cases of traumatic stricture, especially where the urethra has been torn completely across, or where there is occlusion of the canal at the seat of injury, an exception may be made and the short catheter used through the perineal wound. After he had performed external division in the perinæum for occlusion of the urethra at the seat of injury, the writer once debated the propriety of leaving in a gum catheter and renewing the instrument daily for a week, the same instrument never to be employed a second time, in order to avoid the danger of phosphatic incrustation. But this plan was not carried out, and the patient got well without the aid of the catheter.

35. The eighth rule of Syme should not be departed from; on the contrary, the use of large instruments should be continued indefinitely, and not, as sometimes recommended, only during the progress of convalescence. It is well known that, if large instruments are not introduced at intervals of a week or two after union of the wound, recontraction will almost always occur, although probably not to such a degree as to cause so narrow a stricture as before, unless the original troubles recur—as virulent urethritis, perineal contusion, debauch, etc., etc. Patients, who have been taught to introduce their own steel sounds, should, for as long a time as possible, be retained under observation, and the importance of keeping the instruments free from rust and smoothly polished, and the necessity of great gentleness in their use, constantly impressed upon them; for, careless and rough manipulation, by exciting urethritis or by tearing the mucous membrane, is likely to cause a relapse.

36. The term large instrument is only relative; the diameter of the sound should be proportionate to that of the uncontracted part of the urethra, and if the meatus be abnormally narrow, it should be freely incised and the caliber of the canal then ascertained. Some urethræ will only admit No. 12 of the English scale, while others easily take in No. 18, which equals 10½ millimeters in diameter.

37. The use of dilating instruments during and long after the granulating process of the incised wound made for the relief of the strictured part of the urethra, is intended to secure a wide cicatricial splice and thus allow for subsequent contraction, as in the case of a deep burn near the flexure of a limb which is kept extended during the progress of cicatrisation. Reybard, after demonstrating that longitudinal wounds of the urethra are not followed by stricture, recommended that, in cases requiring stenosiotomy, dilators be used periodically, during the healing process, so as to increase the width of the cicatrix. The efficacy of this after-treatment of incised urethral strictures has been fully appreciated by the many surgeons who have put it into practice.

38. To form a correct idea of the real value of external perineal division of urethral strictures, it is needful to take into consideration: 1, under what circumstances is the operation justifiable; 2, what amount of danger attends its performance; and 3, how far it is entitled to be considered as a means of cure.

39. The last two inquiries were phrased by Sir Henry Thompson, who said: "It has been stated that the hazard to which the patient's life is exposed by the opera-

tion is too great to be incurred for the sake of obtaining a cure of his complaint. This view has not improbably arisen, in some measure, from the still common but erroneous habit, already alluded to, of confounding external division of a permeable stricture upon a sound with the operation upon an impassable one without it." In a published lecture, Professor Van Buren remarked that "the dangers of this operation depend upon the conditions which necessitate its performance, rather than upon the proceeding itself. If, as is always desirable, its necessity has been foreseen, and time secured for the examination of the internal organs, and ample preparation made, the danger is trivial; but if, on the contrary, as often happens in hospital practice, the patient falls into the surgeon's hands with prolonged retention or extravasation of urine, from recklessness and neglect, the operation is likely to be much less favorable. And if, in addition to these serious complications the stricture should prove to be impassable, and the operation is necessarily undertaken without any guide to the bladder, it becomes one of the most difficult and uncertain proceedings of surgery. The alternative of puncture of the bladder from the rectum, or above the pubes, may in rare cases be adopted from necessity; but these measures afford only temporary respite, inasmuch as they leave the stricture, the cause of all the trouble, unrelieved." The views of Dr. Markoe were expressed in a clinical lecture as follows: "It must be evident to you that the success or failure of it depends upon the condition of the patient for which the operation becomes necessary, that the dangers of the operation itself can hardly be separated from those of the disease

for which it is performed. Being a last and only resort for a desperate condition of things, we can not select our cases nor prepare them for the operation." In the third edition of his work on "Diseases of the Bladder, Prostate, and Urethra," Professor S. D. Gross said that, "The operation is by no means free from danger, and requires the most consummate skill for its successful execution. None but a madman or a fool would attempt it, unless he had a profound knowledge of the anatomy of the parts, and a thorough acquaintance with the use of instruments."

40. The views, just quoted, of these distinguished surgeons, pertinent to the estimate of the operation, are fair indices of the general trend of opinion among surgeons at home and abroad. But there is need of a broad interpretation of the words "the operation being a last resource." While, beyond all question, the conscientious surgeon must employ all available and justifiable means of relief before resorting to a cutting operation, yet, when these have failed after judicious trial, the knife is not only the "last resource," but the only resource, and must be promptly and resolutely applied; long delay being too often fatal. The operation has frequently been deferred so long, that the bladder and kidneys have become irreparably damaged by the action of the stagnant, infected urine, and finally the knife is used when all operative procedures are contra-indicated. This long delay accounts, in a great measure, for the large percentage of mortality which followed the operation as performed during the second half of the eighteenth century, and which then led to its condemnation by such eminent men as Desault, Chopart,

Sharpe, and others, and to its disuse. Its revival, so creditable to American surgery, is justly ascribed to Alexander H. Stevens, who, in 1817, incised externally a stricture of the perineal region of the urethra with entire success after the failure of the common modes of treatment. A full account of this case is printed in the "Medical and Surgical Register, etc., New York Hospital," p. 75. From April, 1820, to December, 1823, Dr. Horatio G. Jameson, of Baltimore, had performed ten external perineal stenosiotomies without a death. An account of these operations appeared in the seventh volume of the "American Medical Recorder" for 1824. Dr. David L. Rogers published, in the fourteenth volume of the "Philadelphia Medical and Physical Journal," the results of twelve external urethrotomies for stricture, the first of which he had performed in 1823. And two perineal operations for stricture by Dr. J. C. Warren were reported in the July number, 1829, of the "Boston Medical and Surgical Journal."

41. The first consideration, namely, under what circumstances the operation is justifiable, has been discussed with warmth, and extreme views taken thereof, by three differing sets of surgeons. Those of the first set resort to cutting forthwith, in every case of narrow stricture, and assume that no other mode of treatment is applicable. The second maintain that a cutting operation "is not necessary in cases where an instrument can be passed into the bladder." Those of the third set are of opinion that "the hazard to which the patient's life is exposed by the operation is too great to be incurred for the sake of obtaining a cure of his complaint," that, consequently, it is unjustifiable, and that under no cir-

cumstances should it be resorted to. These diverse views have caused no little perplexity in the minds of the inexperienced.

42. The advances that have been made in the knowledge of the pathogeny and treatment of stricture of the urethra indicate a moderate and middle course to be pursued. It is now believed, by conservative and judicious surgeons, that the class of cases which require this operation is small, and that, even in this class, before resorting to the knife, gradual dilatation and all other rational means of relief should be tried. But impermeability, resiliency, or great irritability of strictures, are indications by which these surgeons are influenced in the adoption of the mode of treatment by external incision. No doubt is now entertained of the propriety of the operation for the relief of impassable strictures attended with obstinate urinary fistulæ or with retention or extravasation of urine, and for narrow constrictions of traumatic origin.

43. The proper appreciation of the second consideration, "What amount of danger attends the performance of the operation," is of the greatest importance, since its risks have been much exaggerated; some of them being more imaginary than real.

44. Much credit is due to Professor Syme for recalling the attention of the surgical world to the operation, and for demonstrating, by a large number of successful cases, that it is not as perilous as was formerly believed, provided it were done with due caution and at the proper time. Now, the operation is as firmly established, and is regarded as safe as lithotomy, so long as there are no renal complications, even when no guide

can be passed. In the writer's experience the operation without conductor has been attended with no ill results.

45. Mr. Syme made permeability a prerequisite to the performance of his operation. He assumed that there are no impermeable strictures of idiopathic origin, and that, if urine flows through the canal, an instrument can be made to enter the bladder by the exercise of patience and of sufficient dexterity. Many surgeons of experience have been able to verify the fact that there are certain strictures which are impassable to instruments of the smallest diameter while they are permeable to the urine, and this, together with Mr. Syme's acknowledged failure, in after years, to introduce a conductor in some instances, renders it superfluous to give any examples or to defend the operation in impassable or even in impermeable strictures, when the other indications are clear, especially since for the last half century the external section has been done in this country, for such cases, with the greatest success.

46. On the other hand those extremists, who maintain that permeability to instruments necessarily contraindicates the operation, meet with very few supporters. The aim of the majority of surgeons, in our day, is to endeavor to pass in a conductor, but, when this is not practicable, they operate without guide, for the double purpose of dividing the stricture and of relieving or averting retention of urine.

47. The following statistical summary gives the results of the external perineal division of strictures, prior to the year 1870, by American surgeons. The number of cases collected is 345, of which 233 were without conductor. There were in all forty-one deaths;

about twelve per cent. The assigned causes of death were: advanced disease of the bladder and kidneys in twenty-two cases; "pyæmia" in fifteen cases; erysipelas and "pyæmia" in one case; intra-pelvic abscess and "pyæmia" in one case; and thrombosis in two cases.

48. Professor Miller, of Edinburgh, regarded the following as the principal dangers which attend the performance of the operation: 1, hæmorrhage; 2, infiltration of urine; 3, abscess in or near the wound, leading perhaps to fistula and "irritative fever"; 4, intra-pelvic abscess; 5, erysipelas; and 6, "pyæmia."

49. Not a single case of fatal hæmorrhage is mentioned as having occurred among the 345 patients referred to above, the prominent features in many of which were kindly furnished by the operators. Of these 345 patients there were but two who lost more than the usual amount of blood; in one case the hæmorrhage was from an anomalous branch of the artery of the bulb, which was controlled by ligature; in another case—one of the writer's patients—about one pint of blood was lost, from oozing, but the hæmorrhage ceased spontaneously and did not recur. Troublesome hæmorrhage would, then, seem to be of very rare occurrence in this operation, though among some cases reported by Sir Henry Thompson, Professor Syme, and Mr. Henry Smith, there were a few fatal results from that complication.

50. Infiltration of urine, after the operation, is only liable to occur when the external incision is small, or when the attendant has neglected to keep the scrotum well supported by the sling bandage.

51. Abscess in or near the wound is not likely to form

if the lips of this wound are kept asunder and slow union from the bottom by granulation promoted.

52. Intra-pelvic abscess was reported once only as occurring among the 345 cases before referred to, and there "pyæmia" coexisted. The intra-pelvic infection is secondary, unless the perineal incision involve the deep pelvic fascia, and it can scarcely be conceived that, in our days, any urethral constriction should render necessary such an extended incision.

53. Of erysipelas, the writer has witnessed its coexistence in but one case, and, in that instance, neither the wound nor the genitals were affected. Such a complication belongs to the wards of an infected hospital and is liable to complicate any surgical operation. "Pyæmia," or more properly, sapræmia, may be placed in the same category as erysipelas.

54. The analysis of the 345 instances of external perineal division of strictures showed that death, in the largest proportion of cases, was due to advanced disease of the bladder and kidneys—chronic cystitis with much thickening of the bladder walls, pyelitis, and renal abscesses having been found in many of the cases. This condition of the urinary organs can generally be discovered in time for the surgeon to form an unfavorable prognosis, and to decline performing an operation which, under the circumstances, is so manifestly contraindicated. Deducting the twenty-two deaths which were attributed to this cause, leaves a mortality of about five and a half per cent. as the legitimate mortality from this operation.

55. The third consideration, namely: how far the operation is to be regarded as a means of cure, is worthy

of attention and should be viewed, as suggested by Thompson, under the following heads: "*a*, it may fail to afford any relief; *b*, it may cure for a short period, and afterward be followed by a relapse; *c*, it may effect a permanent cure."

a. It may fail to afford relief if the stricture has escaped division, or "if the occurrence of sloughing has prevented the possibility of union of the wound." The writer has observed cases of failure from the first-named but never from the second cause; fatal cases being of course excluded.

b. It will only afford temporary relief if the stricture has not been completely divided, or to the too rapid union of the wound, or if the patient has neglected the periodic introduction of a sound, or if there is a recurrence of the original cause of the trouble.

c. It will afford permanent relief only so long as the patient continues the use of a full-sized instrument at intervals of a week or two. There is no mode of treatment for obstinate stricture which will effect a permanent cure without the periodical use of the sound. Exceptions to this rule are few.

55. Since the first edition of this paper, the writer's experiences with the different methods of treatment of narrow, dense, resilient strictures of the perineal region of the urethra have led him to reject internal urethrotomy and adhere more closely than before to external urethrotomy as by far the safer and more satisfactory operation.

X

INJURIES OF THE URETHRA

1. The urethra is subject to violence inflicted *A*, from within, and *B*, from without, and such violence is followed sooner or later by constrictions of the canal styled traumatic strictures. To this rule must be excepted internal and external longitudinal incised wounds, whether accidental or designed, otherwise surgery would be deprived of the surest means of cure applicable to certain urethral strictures.

2. *A. a.* Injuries from within are inflicted by the impaction of gravel or of foreign bodies; *b*, by caustics and also by electrolysis employed in the treatment of strictures; *c*, by forced catheterism; *d*, by the prolonged retention of catheters in the canal; *e*, by contusions from roughly used catheters and bougies; *f*, by lithotriptic instruments; *g*, by the sudden and forcible withdrawal of small bougies that have become knotted in the urethra or bladder; *h*, by the extensive gangrene which is sometimes due to extravasation of urine.

3. *B. i.* Injuries from without which cause strictures are inflicted by transverse incisions of the urethral canal; *j*, by the cutting instruments and by the forcible extraction of large stones in lithotomy; *k*, by the "breaking of the chordee" in super-acute urethritis; *l*, by torsion of the erect penis; *m*, by lacerated wounds in the

phallic and perineal regions; and *n*, by contusion of the perinæum.

4. *A. a.* Serious injury is inflicted by the impaction of a gravelly mass or of an angular fragment made by the lithotrite; the immediate effect of which is the damming up of the urethral canal and sometimes retention of urine. If undisturbed, either of these bodies gives rise to a local inflammation of the mucous membrane and, becoming incrusted with the salts of the urine, gradually increases in size; forming an ampulla for its lodgement, besides causing a stenosis of the urethra which steadily decreases in caliber anteriorly to the ampulla, and is the source of much distress at each of the very frequent acts of urination. The gravelly mass or fragment may be arrested in the balanic, phallic, perineal, or prostatic region. Professor J. S. Davis, of the University of Virginia, related to the writer the history of a case, communicated to him by Dr. J. B. Taylor, illustrating some of the effects of the impaction of a calculus in the fossa navicularis. The patient, thirty years of age, was in great distress owing to impeded urination. The whole penis was much swollen and the glans was of the "size of a man's fist," red and sodden from dribbling urine. The sufferer declared that he had felt no pain nor had known anything of his real condition until the day before invoking medical aid. His father, with whom he lived, knew little of the son's ailments, except that he had been troubled with "the gravel" in childhood. Examination revealed the presence, in the balanic region, of a large calculus which, three days after the use of evaporating lotions, was extracted through a free incision beginning at the meatus.

The parts soon healed and the patient made a good recovery. The nearly spherical stone measured four inches and seven-tenths in circumference. Much to the injury of the urethra, calculi are often arrested in the phallic region that have easily passed through the more expansible posterior regions or are impeded in their outward course by slight constrictions in this phallic region. The writer has been obliged, in such cases, to incise the canal internally before the calculus could be extracted, or to perform urethral lithotripsy. The well known external section through the phallic region for the extraction of an impacted calculus described by Celsus needs only casual mention. Then too there is, in the fifth chapter of the second book of Ætius, a record of Philagrius' operation of urethral lithotomy by a superior incision between the cavernous bodies of the penis with intent to avoid a urinary fistula which he believed must occur from division of the inferior urethral wall. Such an operation would now very properly be condemned. Many accounts have been given, by divers authors, of the disastrous effects of calculous impaction in the scrotal and perineal regions of the urethra. Sir Everard Home recorded the case of a boy six years of age who died from the effects of a urethral stricture caused by an imbedded calculus. The writer once had to perform external perineal urethrotomy to open a large ampulla, extract therefrom a calculus fifteen millimeters in its short and twenty-five millimeters in its long diameter, and to divide a consequent narrow stricture at the anterior extremity of the ampulla. This calculus had remained in that region for fifteen years. The patient, sixty years of age, though in a very unpromising con-

dition, owing to chronic cystitis incident to urinary stagnation and decomposition, made an excellent and rapid recovery, and was seen six years afterward when there was no trace of his former troubles, and he was still using urethral dilators. In the prostatic region also, masses of gravel occasionally lodge, which, unless promptly crushed, by means of any of the ingenious instruments devised for the purpose by Leroy, Mercier, and other surgeons, grow very rapidly in size and cause much distress and difficulty in urination. In such a case, the lateral operation was undertaken by a colleague believing that the stone was in the bladder. The patient died in the course of a few days from pyelo-nephritis. The writer, who had the opportunity of examining the parts, post mortem, found no evidence that the urethro-vesical orifice had been cut or dilated but that the stone had been lodged in the greatly distended prostatic sinus whose capacity was estimated at three ounces, the real bladder being in a state of contracture and of very little greater capacity than the ampulla. Many, indeed, are the grave physical disturbances caused by the impaction of calculi and by the lodgement of foreign bodies in the urethra, such as ulceration, stricture, and retention of urine and its sad consequences, besides the laceration of the parts, hæmorrhage, and inflammatory action resulting from their dislodgement or extraction.

5. *b*. The ill effects of caustics in the treatment of strictures and other urethral affections have been such as to merit very particular attention. The excuse for the use, or rather abuse, of caustics, which were largely employed until comparatively recent times, was grounded

upon the reports of John Hunter, Ducamp, Sir Charles Bell, Whately and Leroy, who all resorted to this pernicious treatment under the erroneous impression that a urethral stricture is constituted by a characteristic morbid plasmatic substance to be destroyed in order to give free issue to the urine. These and other eminent men, seeing that the jet of urine was sometimes freer after cauterisation of the parts with silver nitrate or potassa fusa, continued to thus cause the destruction of the urethral mucous membrane after whose cicatrisation there followed a worse and much more extensive and intractable stricture, until they witnessed this baneful after-effect in very many cases. Reybard, of Lyons, was the first to prove, by careful experimentation, that a grain or two of pure nitrate of silver applied to or near the seat of a stricture, causes an eschar involving the whole thickness of the mucous membrane, which, after cicatrisation, produces the most obstinate constriction. When potassa fusa is used in very minute quantity it has no effect, otherwise it is followed by a deep slough and a rapidly contracting cicatrix. Lallemand's treatment of spermatorrhœa with the solid silver nitrate is too often followed by stricture; the silver salt, before reaching the prostatic region, very frequently acting upon the perineal and membranous regions of the urethra and there causing eschars which result in the formation of dense strictures. Electrolysis also has caused the same untoward condition which the writer has observed in patients that had been so treated by exponents of electrolysis.

6. *c.* Forced catheterism is known to have inflicted some of the gravest injuries to the urethra, notably

lacerations and false routes. Rigid instruments of large caliber forcibly thrust onward have so torn the urethra in front of the stricture sought to be dilated, after the manner of Mayor, as to leave a ragged wound through which the urine filtered into the ambient connective tissue; the effects being infection, destruction of the adjacent tissues, more or less abundant suppuration, the establishment of a urinary fistula, and the formation of a true traumatic stricture. False routes are made generally in the floor of the urethra by a large as well as by small, by non-metallic as well as by metallic instruments. The most common of the false routes occur in the form of pockets from a quarter to three quarters of an inch in length; they are often multiple, and are sometimes made when comparatively little force is used; the instrument ploughing its way in the sub-mucous connective tissue. Although the least dangerous of the urethral injuries, they are very often serious impediments to subsequent catheterism. False routes are made in all parts of the urethral canal, above, below, at the sides, from the balanic to the prostatic region inclusively, but occur most frequently at the two particularly vulnerable points of the urethral canal, namely: the peno-scrotal and the bulbo-membranous junctions. The offending catheter or sound often re-enters the urethra at a short distance behind the stricture and so leads to the belief of its successful passage. In some cases it travels a long distance in the tissues before re-entering the urethra and has been known to pursue its wayward course to the base of the bladder and to enter that organ at its lower fundus, or to perforate the rectum or else insinuate itself between the rectum and

bladder and reach the peritoneal cavity. A case of this kind occurred in one of the large hospitals; the patient dying from the effects of urinary infiltration in the pelvic cavity and of septic peritonitis. In another case the instrument perforated the upper wall of the urethra in the phallic region, entered the cavernous substance of the penis, and caused death from hæmorrhage and general infection.

7. *d.* The prolonged retention of catheters either in the treatment of strictures by lengthened continuous dilatation or after internal or external coarctotomy, has often caused rigors, urethritis, cystitis, perforation of the bladder, and ulceration through the urethra and teguments. Such ulcerations and perforations have occurred from the retention of the catheter for two, three, or four weeks, and in exceptional cases for but a few days. The writer has witnessed several cases of this sort, one in particular where the retained silver catheter was seen through an ulcerated opening one inch in length at the peno-scrotal junction. He induced the surgeon in charge of the case to remove the instrument in order to avoid further damage. This cause of urethral ulceration is now extremely rare, for the fashion of using the *sonde à demeure* has passed away.

8. *e.* Contusions of the urethra, with catheters or bougies, chiefly at the meatus and at the bulbo-membranous junction, cause ecchymoses and inflammatory action resulting in induration of the parts and later in more or less constriction. These local lesions occur among patients, suffering from strictures or from prostatic obstruction to urination, who catheterise themselves carelessly, with undue frequency, or with worn-

out instruments. In some of these cases even the whole urethra to the bulbo-membranous junction is in an almost hopeless state of contraction.

9. *f.* Lithotriptic instruments of large caliber often tear the urethra at or near the bulbo-membranous junction, or even at the vesical orifice and prostatic region during their introduction and also during their withdrawal, especially when overcharged with calculous detritus. These injuries at the bulbo-membranous junction of the urethra are followed by rapidly contracting strictures, unless proper means be used to combat them. When the lacerations in the prostatic region are followed by sloughing and much loss of substance, cicatricial bands are sometimes formed which interfere with catheterism and favor the lodgement of gravelly matter. One of the authors who described and figured such bands characterised them as strictures of the prostatic region of the urethra.

10. *g.* The flimsy gum bougies used in the *cathétérisme à la suite* of Maisonneuve to guide his urethrotome, often coil in the urethra and are cut by the blade of the instrument; but their less common freak has been to tie themselves into knots when used for simple dilatation. One of these bougies, No. ½, so used in the treatment of a dense and narrow stricture in the phallic region, was passed successfully, but when the house surgeon endeavored to withdraw the instrument it met with such resistance at three inches from the meatus that he suddenly and forcibly pulled it out to find it tied into a knot one inch above its free extremity. From the amount of hæmorrhage which followed, it was evident that the weakened urethra behind the stricture was

torn across. This accident converted the existing idiopathic into a traumatic stricture; the predominant traumatic element fully justifying the internal stenosiotomy which was performed two weeks later.

11. *h.* The extensive gangrene often due to extravasation of urine from rupture of the urethra behind strictures of the perineal region, sometimes sweeps away the greater part of the urethral caliber. This effect of gangrene was witnessed in several instances, but in one case about three-fourths of the caliber of the canal and the whole length of its perineal portion and surrounding tissues had sloughed away, leaving a wide gap which could not be filled, but, fortunately, urination through this opening was not impeded.

12. *B. i.* Injuries from without are inflicted by longitudinal and transverse incisions of the urethral canal. The first are not followed by stricture, but, as a general rule do not close when they occur in the phallic region; whilst the second are invariably followed by stricture. The subjoined is a fair example of an unclosed longitudinal wound. A young man suffering from a stricture seated at about one inch in front of the peno-scrotal junction, applied for treatment to a physician who performed division of the strictured part of the urethra by a free external incision. The edges of the wound soon sloughed and half of the caliber of the canal was destroyed for a space of sixteen millimeters—five-eighths of an inch. After cicatrisation of the parts there was still left a wide gap about five-eighths of an inch in length. One year after this the patient came for relief to the writer, who closed the urethral chasm by a plastic operation; using for the purpose some scrotal skin, the

epidermic surface having been turned in to take the place of the lost mucous membrane. The operation proved successful, the wounds healing primarily. Of transverse incised wounds, many cases are on record, among which are those incident to amputation of the penis. Their effect upon the urethral stump has already been described under the head of strictures at the extremity of the urethra. A striking example of transverse incision of the urethra, followed by stricture, is given by Reybard,* as follows: "A medical man, in a fit of suicidal mania, cut open his larynx with a razor and then his urethra transversely in the phallic region. The parts were promptly brought in apposition and healed primarily. Six months afterward, Reybard discovered, at the seat of the urethral injury, a well-marked stricture through which a bougie five millimeters in diameter was passed, not, however, without difficulty." Vidal (de Cassis) cites two cases of self-inflicted amputation of the penis; one close to the pubes, but gives no account of the ultimate result. In the other case stricture ensued. He makes mention also of Boyer's case of complete transverse division of the canal followed by stricture. Professor Paul F. Eve† gives the details, gathered from divers medical journals, of five cases of self-inflicted amputation of the penis. A patient, moribund from loss of blood, was admitted to Bellevue Hospital in the service of the writer, who found that the man had just cut away his penis and testicles. He died within an hour of his admission. A second patient, despite very

**Traité pratique sur les rétrécissements du canal de l'urètre.* Paris, 1853.

†A collection of remarkable cases in surgery. Philadelphia, 1857.

profuse hæmorrhage, lived two days after his erect penis had been cut completely across with a razor.

13. *k.* In lithotomy with the different gorgets, with the *lithotome caché*, by the medio-lateral, by the medio-bi-lateral method, and even by the modern lateral method with a beaked bistoury, the urethra has often been cut so nearly transversely as to cause troublesome traumatic strictures. In the median operation of Allarton, when the finger is used as a dilator, particularly in young children, the membranous portion of the urethra has been severed from the prostate, and in other cases when the stone is extracted forcibly, the membranous, with half of the prostatic portion, has been destroyed, and the rectum torn open. A boy under ten years of age was brought to Bellevue Hospital suffering from a recto-urethral fistula, through which the index finger could be introduced. This was the result of a median lithotomy with the extraction of a large stone. It was the serious injury so often inflicted upon these parts by the forcible extraction of large stones in adults that induced Vidal to propose quadrilateral lithotomy, as he regarded four moderate incisions at the urethro-vesical orifice less injurious than laceration and its ill consequences.

14. *l.* "Breaking the chordee" in super-acute urethritis sometimes occurs spontaneously or from some slight hurt during erection of the penis. It has happened, as reported by Franc, when the patient had turned abruptly in bed.* The breaking of the "chordee" is often brutally effected by placing the erect penis upon

*Observations sur les rétrécissements de l'urètre par cause traumatique. Montpellier, 1840.

a board or table and striking it violently with the fist or edge of the open hand. This traumatism is followed by a profuse hemorrhage and later by a dense stricture.

15. *m*. Of the effect of torsion of the penis, but one case was observed. It was that of a man thirty-two years of age who was suffering from a stricture due to urethritis, and who, in a drunken state, attempted the marital act, and, failing, his wife, also crazed with alcohol, seized the semi-erect penis, bent it upon itself, then pulled and twisted it violently. Immediately there was a free flow of blood by the meatus and then a general ecchymosis involving the penis, scrotum, and hypogastric region. Six weeks later, it became necessary to divide externally the old stricture in the perineal region, and also that in the scrotal region caused by the injury. The patient made a good recovery and promised to continue the use of dilators.

16. *n*. Lacerated wounds of the perineal urethra, from fracture of the pubes or from shot wounds, cause strictures which contract with great rapidity. A man twenty-four years of age fell and was crushed in the region of the hips between two canal boats which were in motion. In a few minutes blood was flowing from the meatus and continued to escape with the urine which dribbled away for the ensuing twelve days. Catheterism soon became very difficult, and in the course of three months, was no longer possible. Two months after the accident, an abscess opened spontaneously in the hypogastric region and another in the middle of the right thigh, through which the urine flowed; none passing by the natural route. A flexible catheter inserted by the fistulous tract in the hypogastric region reached

the bladder and gave vent to purulent urine. By rectal exploration it was ascertained that the rami of the pubes and ischia were very much out of place, that they encroached greatly upon the pelvic outlet, and that this deformity was the result of a fracture. He died on the nineteenth day after external division of the stricture consequent to the injury. Necropsy was not permitted. Another case of laceration of the urethra from fracture of the pubes was treated fourteen months afterward. The patient, forty-six years of age, was crushed between two heavy stones. In eight hours he passed bloody urine and continued to do so for two weeks. Dysury began four weeks after the injury, and then occurred complete retention of urine, for which he sought relief. Dilatation was of so little avail that the stricture was twice divided externally, with a final good result. A private soldier twenty-eight years of age was struck by a fragment of a shell, which lacerated the penis. In five days, owing to the grangrenous condition of the organ, it was necessary to remove it a little in front of the scrotal junction, leaving a stump of about half an inch which did not heal until eleven months after the operation, when the urethral extremity had contracted almost to a pin hole and urination had become very difficult and painful. At length a perineal abscess was formed which when opened gave free issue to the urine; the urethra having been included in the incision. After this, the end of the canal closed completely and urination was effected entirely through this vulva-like opening.

17. *o.* Contusion of the perinæum is the most frequent of the injuries affecting the urethra and causing its coarctation. It occurs ordinarily from falls astride of

some hard resisting body such as iron railings, the edge of a joist or board, the wheel of a wagon, the back of a chair, and has even been inflicted by a kick in the perinæum. The extent of damage done by perineal contusions is dependent upon the degree of the violence. In some instances the effused blood may infiltrate only the tissues surrounding the urethral bulb, or the meshes of the spongy substance itself, or may reach the submucous tissue, forcing in the mucous membrane and so closing the urethral canal and causing retention of urine, or the bulb may be so crushed against the pubic symphisis as to be converted into a pultaceous mass, or the mucous membrane alone may be cut sharply across near the bulbo-membranous junction as the urethra is jammed against the sub-pubic ligament. Then again the urethra may be completely severed and its ends retracted from half to three-quarters of an inch or even more. Some of these conditions were verified not only by cadaveric experiment but by observation on the living.

18. In establishing the diagnosis of the lesions due to contusion of the perinæum, inquiry is made into the exact nature of the accident, the amount of urethral hæmorrhage, the beginning of retention or of extravasation of urine, and the degree of ecchymosis and of perineal tumefaction. When inability to urinate does not occur until several hours after the infliction of the injury without apparent hæmorrhage, it may be inferred that the obstruction is due to a blood clot underlying the mucous membrane. When, however, there is urethral hæmorrhage, its amount will be a fair indication of the extent of injury. Slight bleeding presupposes

a simple wound across the mucous membrane such as may be made by any sharp instrument, whilst profuse bleeding is indicative at least of a deep rent involving the corpus spongiosum. Another sign of injury implicating the whole thickness of the lower urethral wall is the excruciating pain at first felt during urination, from contact of the urine with the wound. Retention of urine rarely occurs when only the mucous membrane has suffered the incised wound to which reference has been made, except when the canal is closed by a large impacted coagulum. When the urethral ends are retracted, after a violent contusion of the perinæum, infiltration of urine is certain to occur at the first act of micturition, unless preventive means have been taken, and the distended bladder relieved artificially. Such urinary infiltration is always a serious complication to be prevented whenever threatened. Fortunately, however, when the urethra is completely severed, there is total inability to urinate, owing at first, to the shock caused by the violence of the blow sufficient to rend the canal, and then to the retraction of the vesical end of the torn urethra and its plugging by clotted blood. If such a case happens to fall into the hands of an overanxious medical adviser who endeavors to empty the bladder by means of a catheter, failure to reach that organ will be almost certain, and it is more than likely that a false route will be made by the point of the wandering instrument and so increase greatly the difficulty of subsequent procedures. It is surely very unwise, in such instances, to resort to catheterism, since the distended bladder can be relieved so quickly, for the time being, by supra-pubic capillary puncture and aspiration

of the urine, and thus leave abundant time for a deliberate operation upon the injured parts.

19. Traumatic lesions of the urethra are followed by stricture just so soon as the parts are cicatrised; the further progress of the constriction depending upon the degree of violence inflicted. In the case of perineal contusion without laceration of the urethra or loss of substance, several years may pass before the stricture causes any grave impediment to urination. But when the mucous membrane is severed or the canal lacerated, the urethra becomes so tightly constricted at the seat of injury in the course of a few months or even a few weeks as to be permeable only to the smallest bougies. Of twenty-five cases of injury in the perineal region observed by the writer, twenty were followed by rapidly contracting strictures, and five were subjected, within twenty-four hours after the injury, to external perineal urethrotomy with intent to prevent the formation of stricture. All of the twenty cases of perineal injuries followed by stricture were treated by external division. Eighteen recovered and two died. The immediate treatment of the five cases of perineal contusion was in accordance with Reybard's aphorism: "All contusions of the urethra are followed by organic stricture, sooner or later, according to the extent and degree of disorganisation." Boeckel's briefer aphorism,* referring, however, only to urethral rents is as follows: "Every transverse rent of the urethra is the germ of a stricture." He acted agreeably to this aphorism by making external perineal division in the case of such a wound of the urethra primarily to relieve the distended bladder.

*Eugene Boeckel. Gazette Medicale de Strasbourg, 1868.

20. The purposes sought to be attained by immediate external perineal division of the urethra, in cases of transverse wounds, are: to give free egress to the urine; to prevent urinary infiltration or to limit it in case of its occurrence; to allow the free escape of extravasated blood; and to favor the interposition, at the seat of injury, of a wide longitudinal cicatricial splice to be maintained by the long use of dilators, and thus nip in the bud the embryonic stricture.

21. Whenever there is retraction of the ends of a wounded urethra, endeavor should be made to bring these ends in apposition by means of fine catgut sutures, and then to make a longitudinal cut three centimeters or thereabouts in length, along the floor of the canal. No instrument should be passed into the urethra through the phallic region as a preliminary step for the reason that it would be of no good use and would, in point of fact, be in the way and otherwise be hurtful, but a free central longitudinal incision should be made down to the urethra, whose retracted ends should be freed from clots. Before applying the stitches, a very broad grooved director should be coaxed into the bladder and in the groove of this director should be slid a rubber catheter to draw off any contained urine; this catheter to be retained in position not longer than three days. Meanwhile the bladder should be irrigated twice or thrice daily, with a solution of acetate of lead, five centigrammes of this lead salt and the same quantity of acetic acid to thirty grammes of warm water, in order to counteract phosphatic incrustation of the catheter. In two or three days after removal of the catheter, a full-sized sound should be passed carefully and gently through

the whole length of the urethra, and this catheterism repeated every three or four days until closure of the external wound, then once each week for a year and once each month for an indefinite time.

22. In regard to the ultimate result of this operation employed as a preventive of stricture, the writer can cite but two out of the five cases so treated by him, one of which he had under observation for five years, and one for twenty years. In neither case was there any sign of stricture formation at the seat of injury. The others were hospital cases and could not be followed beyond a few months.

23. Surgeons have long since agreed that not only should recent wounds of the urethra be treated by free incision of its lower wall in order to prevent the otherwise inevitable stenosis of the injured part, but that all other hurts of that canal be subjected to internal or external division according to the seat of the injury, and that all traumatic strictures—so absolutely refractory to dilatation—should be early incised; no other mode of treatment having ever been known, in such cases, to afford lasting relief.

XI

RETENTION OF URINE DURING URETHRITIS

1. Retention of urine during acute and chronic urethritis is of sufficiently frequent occurrence to merit such notation as may be likely to dispel the erroneous impression, long prevalent among physicians, respecting the kinds of urinary retention commonly ascribed to swelling and to spasm, and inaccurately specialised as "acute inflammatory stricture, and spasmodic stricture" of the urethra. These designations began to be employed before the true pathogenesis of stricture was known, and before the advent of methods of precision in urethral exploration, and may now be regarded as relics of archaic medical literature preserved by ardent votaries.

2. The condition specified by many of the old writers as "acute inflammatory stricture," does not exist in the perineal or anterior, but is discernible in the posterior segments of the urethra as far as the vesico-urethral orifice, and can not, in any sense whatsoever, be regarded as stricture. This morbid state is a common cause of retention of urine, from acute as well as from chronic urethritis, even in patients whose urethra had never before been diseased, and is in reality the occurrence of œdema of the urethral mucous membrane, in its posterior regions, sufficient to close the passage just as œdema of the glottis closes the larynx. When urethral

œdema occurs soon after the backward extension of the inflammatory process, it is generally excited by undue exposure to the elements, during a debauch in wine or venery, on or about the third week of a neglected acute urethritis, and sometimes sooner, or at any time during the existence of chronic urethritis. There being, in these cases, a certain degree of trachœlo-cystitis, urination at first is frequent and painful. The swelling then rapidly augmenting and, in the course of a few hours, closing the vesico-urethral outlet, there ensues complete retention of urine, attended with very great pain, due to the fast increasing vesical distension.

3. The fact that a patient having retention of urine is also affected with acute or chronic urethritis and has been indulging immoderately his appetite for alcoholic beverages, is sufficient to make the physician aware of the real nature of his ailment and to suggest the kind of treatment needed for the speedy relief of the bladder, since, if it should be allowed to become greatly over-distended, the consequences might be of the gravest sort.

4. Formerly, cases of the kind just described were treated locally, by the application of leeches to the perinæum, followed by warm poultices, and constitutionally, by the administration of large doses of tincture of the chloride of iron. When, in about forty-eight hours, a little urine began to escape—involuntarily, from over-flow—it was supposed that the "heroic treatment," without resort to the catheter, had been successful, and there was little thought of the injury likely to be done to the upper urinary organs by the extreme vesical distension; and when, about forty-five years ago, a physi-

cian ventured at once to introduce the catheter in such a case of retention of urine—to the rejection of the regulation antiphlogistic treatment—his practice was regarded as heretical, rash, and highly censurable. But after repeated successes of the rash physician's heretical method, there came a gradual change in the management of the distended bladder, and the catheter began to be used as the first recourse of the medical man to meet the prime indication of emptying the gorged viscus. Suitable means were then used to reduce the vesico-urethral swelling—the real impediment to spontaneous urination in all such cases.

5. Ever since the innovation just mentioned, this method of treatment has been employed with great success by those who rightly appreciate the true pathogeny of the variety of retention of urine in question, with the difference that, while previously a metallic catheter was brought into requisition, now physicians use a curved soft web-catheter, without stylet, not larger than No. 9 of the English scale. The metallic instruments were liable to do serious mischief, and almost always caused hæmorrhage. The soft, pliable silk-web catheters are introduced with ease, and are absolutely safe when rendered aseptic. The introduction of the catheter may not be required more than once when the retention of urine is not of over twelve hours' standing, but when the bladder has become greatly over-distended and cannot empty itself spontaneously after a few days of regular catheterism, the insertion of the catheter every six hours becomes necessary for several weeks, and sometimes for a much longer period.

6. The bladder having been emptied—provided the

distension had been moderate, otherwise only half of its contents should be allowed to escape, for well-known reasons—the local treatment is begun, and consists in the use of rectal suppositories of ice, as suggested by Cazenave. These suppositories are made of pieces of ice, one inch by one inch and a half in size, suitably smoothed. Eight or ten of them are introduced in rapid succession so as to pack the lower end of the rectum. In the course of a few minutes, the ice having melted, the water is allowed to escape, and more of the ice lumps are introduced. This process is continued for about two hours and repeated in two hours. It is rare that more than three such repetitions become necessary. Afterward a suppository of a quarter of a grain of belladonna extract and two grains of opium is inserted. Rest in bed is of course enjoined.

7. The general treatment consists in the administration of alkaline beverages for two or three days; then the tincture of chloride of iron may be given in doses not exceeding five minims thrice daily. The after-treatment should consist of antiseptic irrigations and moderate dilatation of the posterior urethra until all vestiges of the inflammatory process have disappeared.

8. The so-called "spasmodic stricture" has often been the refuge of clumsy catheterists who, failing to reach the bladder, almost invariably assign this failure to the presence of a "spasmodic stricture"—an imaginary obstruction conceived in the mind of the reckless operator whose wandering heavy hand misguides the instrument, much to the injury of a permeable urethra. No just claim can be made for the existence of such a morbid entity as a purely spasmodic urethral stricture, since no

proof has ever been given of the occurrence of spasm of the muscular tissue in a limited area of the perineal or of the anterior portion of the urethra, sufficient to bind, narrow, or close the canal long enough to prevent the passage of the urine, and cause distension of the bladder after the manner of veritable strictures, coarctations, stenoses, angustiæ, all of which terms being used to denote permanent narrowing of the canal. However, it is well known that true urethral strictures are very generally attended with spasm of the ambient muscle tissue, and that this spasm sometimes extends to the membranous region and to the vesico-urethral orifice, particularly during catheterism; but the spasmodic action is ordinarily transitory, lasting only a few moments. Mercier, whose widely published inquiries into the pathogeny and therapy of affections of the urinary organs, including the most extended and exhaustive study of urethral spasm, never regarded this spasm as a stricture in any sense, and this view has been confirmed by many other careful observers. He was perhaps the first physician to call attention to the ill effects of neglected urethro-vesical spasm due to chronic urethritis.

9. When the urinary retention is caused by œdema of the mucous membrane during acute urethritis, it is an acute, complete retention, its onset being sudden, the vesical distension rapid, and the attending pain almost insupportable; that which is the consequence of urethro-vesical spasm, due to chronic urethritis, is a chronic, incomplete retention of urine, its progress being very gradual, slow, and insidious, many months elapsing

before the patient is aware of the existing mischief. In some cases, this kind of retention of urine never becomes complete. Spasms of the posterior urethra can give rise to incomplete retention of urine only when they involve the vesico-urethral muscular bands and are tonic spasms, whilst clonic spasms close the vesical outlet so transitorily as to render possible not only urination, but thorough evacuation of the bladder. After long-continued spasms comes permanent contracture of the vesical neck with its consequent retention of urine.

10. Sufferers from chronic urethritis and trachœlo-cystitis are nearly all dyspeptic and lithuric; the spasms of the posterior urethra being more violent and painful during urination, and being excited by the acrid urine which contains an abundance of uric acid or of calcium oxalate crystals whose sharp corners greatly irritate the diseased mucous membrane. Generally, such patients give little attention to the frequent and painful urination, into whose cause they make no inquiry, and seldom take advice until the spasms have become tonic, or even permanent contracture of the vesical neck is established to produce complete retention and decomposition of the stagnant urine, general cystitis, thickening of the bladder coats and, perhaps, serious morbid changes in the ureters and kidneys.

11. The diagnosis of retention of urine due to spasm of the vesico-urethral muscular bands is not difficult; still, in some cases of chronic urethritis, both clonic and tonic spasms often simulate the presence of stone to such a degree that the physician almost invariably searches the bladder carefully before excluding calculus

as a factor in the morbid condition. During this search, the urine may be allowed to escape through the instrument used for the purpose. If this urine be apparently normal, or contain but a little pus, the presumption is that its stagnation has not been of very long standing, otherwise it may be inferred that general cystitis is fully established.

12. A typical example may serve to illustrate an occurrence which is not uncommon in the practice of physicians. A patient, making vague complaints of some hypogastric discomfort, but unconscious of having retention of urine, or, rather, believing his bladder to be sound, for he had just urinated, is astonished when he sees ten or twelve ounces of urine flow through a catheter introduced by his physician. On the next day, however, he calls, not to express his gratitude, but to denounce peevishly the catheter and the physician, for, as he says, spontaneous urination has not been possible since the passage of the catheter, which he fears has done him lasting injury. An interpretation of this phenomenon, and at the same time an answer to the anxious patient's queries, may be made as follows: The bladder, having long been in a state of distension, is not able to expel its contents when it fills up after the first artificial evacuation, by reason of contracture of all its fibres which are more or less matted in plastic exudation resulting from the existing chronic cystitis. In the great majority of such cases, complete retention of urine may be expected to follow the first and many succeeding catheterisms; therefore, the physician is fully justified in insisting that the patient shall depend, for urination,

entirely upon the catheter, which does no injury whatsoever in careful hands, but serves so well to unburden the dangerously distended bladder. The little inconvenience, the short time consumed in rendering the catheter aseptic, and the very slight pain caused by its introduction, surely are not to be measured with the ill-consequences, or the immediate danger of retention of urine. To prevent invidious remonstrances on the part of the patient, the physician should, at the first consultation, give him a full explanation of the condition of his bladder, and impress upon him the likelihood of complete retention of urine, necessitating the regular use of the catheter until, if possible, the bladder is restored to its normal state, and if not, that the catheter will have to be used for an indefinite period, or a surgical operation may become necessary.

13. Besides recourse to the catheter to relieve the bladder of stagnant urine, and the local management of the existing cystitis, the treatment of spasm of the vesico-urethral outlet should be directed to the chronic urethritis and to the hyperlithuric state of the patient. The fulfilment of these indications, during the early period of the complaint, ensures a permanent cure. But when the contracture of the urethro-vesical bands is fully established, it is necessary to dilate, divulse, or even sometimes incise freely the neck of the bladder by an internal or by an external operation. In any of these circumstances, the after-treatment should consist in periodic stretchings of the vesical neck with suitable instruments until the parts heal, and sometimes for several weeks subsequently.

14. Much more remains to be said on this subject, but it was thought sufficient to sketch only the essential points in the nature, diagnosis, and management of the two kinds of urinary retention described, and to show that the notion of acute inflammatory and spasmodic strictures is misleading, irrational, and contrary to the present state of knowledge of morbid processes.

XII

RETENTION OF URINE FROM URETHRAL STRICTURE

1. Brief descriptions of some of the ready and simple methods of relieving the distress caused by retention of urine due to urethral stricture, and also a few remarks relating to the nature and management of its consequences, will form the text of these notes. This kind of urinary retention is seldom sudden; it is ordinarily preceded by difficult urination whose increase, from month to month, from week to week, from day to day, is proportionate to the diminution of the urethral caliber at the diseased point, and also to the degree of muscular spasm of that part of the canal. For several weeks prior to complete retention, although urination be very frequent, the bladder is not emptied; this constitutes incomplete retention of urine which, from its stagnant state, soon gives rise to cystitis. At length the urine can not be expelled voluntarily; there is then complete retention. This urine, accumulating for thirty-six or forty-eight hours, begins to slobber involuntarily, when the complete relapses into incomplete retention.

2. The laity often regard involuntary escape of urine as cause rather than effect, and endeavor to repress the "undue flow" by sundry processes which, fortunately, prove ineffectual. Meanwhile the vesical distension increases, and unless the patient invoke a physician's assistance without further delay, the urethra is likely to

burst behind the stricture and give issue to the urine which infiltrates and destroys the connective tissue of the perinæum and scrotum. In rarer instances of inordinate vesical distension, a fall, a sudden movement of the body, or a violent struggle during anæsthesia, has been known to cause rupture of the bladder.

3. Long-standing incomplete retention of urine with spasm of the bladder is much more serious than the retention which becomes complete in the course of a few weeks, for, in the first-named conditions, the upper urinary organs are often irreparably damaged and the prognosis is generally unfavorable. It is before the advent of these untoward effects that the greatest good is likely to be accomplished. Therefore, experienced physicians recommend the early treatment of stricture as preventive of retention of urine and its ill consequences; but their instructions are seldom followed, and the responsibility rests with all unruly patients who are too apt to seek advice at the last moment, when the bladder is distended to its utmost degree and the suffering is more than can be longer endured, even by the most stolid of men, after divers nostrums have been tried and found wanting in efficacy.

4. It is too common in such cases to resort to cutting operations, which are indicated only after failure of careful catheterism with filiform bougies, or after suprapubic capillary puncture of the bladder and aspiration of the urine. In ordinary cases it is possible to give prompt relief by making some preliminary dilatation of the stricture; beginning with a No. 1 soft, olive-pointed bougie, and continuing the dilating process by passing successively Nos. 2, 4, 6, and 8, after which it

will be easy to use a No. 7 curved web-catheter that will serve to allow the urine to flow slowly until about two-thirds of the amount of urine contained in the bladder shall have escaped—except of course when the over-distension is extreme, in which case the urine should be drawn by very slow degrees. The catheter is then plugged at its free extremity, is fastened in position, but is not retained more than thirty-six hours during which time some urine is drawn off every three hours, and the bladder finally emptied a few moments before the instrument is withdrawn. After this the stricture is gradually dilated by the use of bougies of increasing size every third or fourth day until the normal caliber and the suppleness of the urethra are restored. Without preliminary dilatation by means of small bougies, it is usually difficult and often impossible to introduce a sufficiently small web-catheter by reason of its flimsiness as soon as it is warmed in the urethral canal. It is not wise to strive to obviate this difficulty by the insertion of a metallic stylet which is so liable to perforate the thin wall of the small calibered catheter, seriously injure the urethra, and defeat the operation.

5. Any stricture amenable to the method of treatment just described may be regarded as an easy case. The difficult cases are those of very narrow, eccentric, tortuous, dense, and resilient strictures which are accompanied by inordinate spasm of the muscular layers and are seated in the perineal region of the urethra. They have been reported with the paradoxical title, "The way to pass impassable strictures," or "How to pass a bougie when it can not be passed." These surgical bulls have come forth from time to time during the past four de-

cades. The idea sought to be conveyed by either title is now expressed in the four words—catheterism in difficult cases.

6. In the management of these difficult cases it is generally necessary to substitute special tools for the regulation implements. One of the simple and ready methods of entering a narrow stricture, whose lumen is eccentric, is by means of a filiform probe-pointed whalebone bougie elbowed at its extremity. This bougie is used partly as an explorer of the narrowed canal and is soon passed through the stricture in nine out of ten difficult cases, and serves as conductor for a No. 1 or No. 2 conical, curved steel staff grooved along its convexity, and having a canal or tunnel two or three millimeters in length beginning at the blunt point of the instrument and ending in its groove. Through this canal is threaded the bougie which guides the staff into the stricture, dilating it sufficiently to permit the introduction of a larger tunnelled sound, then a third, fourth, fifth, and so until divulsion occurs. Then a tunnelled catheter is substituted and enough urine drawn off to relieve the distress of distension. The bladder is not to be emptied until the second day. The object of this delay being to guard against vesical hæmorrhage which is so likely to occur after the too sudden withdrawal of the urine in cases of long-standing distension of the viscus, particularly in elderly men.

7. It sometimes happens that a stricture is so dense that it cannot be dilated by the tunnelled sound beyond No. 2 or No. 3. In that case, a tunnelled catheter, No. 2 or No. 3, is substituted, and through this instrument the urine may be aspirated if it should not flow freely, as

occurs when it is thick and slimy. Then a small web-catheter is passed and fastened in position for forty-eight hours during which time the urine is allowed to trickle out partly through and partly beside the instrument. On the third day it is generally possible to carry on dilatation with less difficulty, and this process of continuous dilatation may be repeated until the stricture shall admit a bougie of the size of the normal caliber of the urethra. When, however, a stricture seated in the perineal region cannot be entered with any kind of bougie, after repeated trials, it is proper to resort to its external division, after the manner already described, with the double object of curing it and of relieving the distended bladder.

8. For some years past there has been a pernicious fashion of dilating the strictured urethra to an excessive degree, and of using the dilators with undue frequency. In the many cases so treated the consequence has been a total loss of the urethral suppleness due to sub-acute urethritis with extensive infiltration of round cells and their subsequent transformation into scar tissue, so that the canal, although greatly increased in caliber, is in a state of permanent contracture.

9. Men of dissolute habits, like the cases presently to be stated, seldom return for treatment until they are again suffering from retention of urine; rarely heeding the physician's warnings, and ordinarily refusing to submit to a year's course of after-treatment by dilatation without which, they are told, it is impossible to keep patent the canal at the seat of narrow, resilient strictures. A debauch in wine or venery is commonly the excitant of these recurring attacks of urinary re-

tention. In such cases the urethral mucous membrane, in front of the stricture and behind as far as the vesical neck, swells, becomes extremely sensitive, and bleeds at the touch of the bougie or catheter whose introduction is more difficult than ever before. As a general rule, when catheterism is unsuccessful, the bladder is punctured above the pubes with a hollow needle and the urine is aspirated repeatedly until suitable instruments can be used to treat the stricture. The following examples may serve to illustrate the efficiency of tunnelled sounds and catheters in difficult cases of urethral strictures with complete retention of urine.

10. W. L. S., twenty-eight years of age, was admitted to Bellevue Hospital on the 8th of April, 1895, suffering much pain from retention of urine which had become complete thirty-six hours before. He had had three attacks of urethritis, the first, twelve years, the second, three years, and the third, eight months before admission to the hospital. The first attack lasted three months, the second, four months, and the third merged into a gleet which existed at the time of his final retention of urine. During the eight months prior to admission, he had repeatedly had complete retention of urine after great abuse of ardent spirits, but spontaneous relief came, except after the last debauch which began early in April, 1895, when, on the morning of the 7th of that month, the retention persisted, but he did not apply for medical aid until the following morning, and the physician employed undue force in using the catheter, with the only result of drawing blood instead of urine. With his bladder distended to the level of the umbilicus, the patient was conveyed to the hospital on the afternoon

of the 8th of April. Exploration of the urethra revealed a narrow stricture in the region of the bulb, and a false passage a little in front of the stricture. The urethra having been filled with oil, an elbowed filiform whalebone bougie was passed through the stricture and, reaching the bladder, was used as a conductor for Nos. 4, 6, and 8 conical tunnelled sounds with which the canal was rapidly dilated, when tunnelled catheters Nos. 7 and 10 were introduced, and eighteen ounces of urine drawn. The patient was then sent to bed after he had taken ten grains of quinine. No anæsthetic agent had been administered. Three-quarters of an hour afterward he passed spontaneously five ounces of urine, without, however, emptying the bladder. In two days the stricture was dilated, or rather divulsed, to No. 12, English gauge; on the fourth day, to No. 13; and on the eighth day to No. 14, which was then introduced every fourth day. He made a rapid and uneventful recovery and was able to urinate in a free stream at regular intervals and to completely empty his bladder. Although this full enlargement of the canal will surely afford him a long exemption from urinary retention, it is more than likely that, continuing his life of dissipation, he will be, sooner or later, again in the hands of the surgeon.

11. E. T., fifty years of age, was received in the hospital on the 22nd of April, 1895, in a profound state of alcoholic intoxication, and suffering from complete retention of urine of forty-eight hours standing. His bladder was distended beyond the level of the umbilicus, although urine had been slobbering out for twelve hours. He was an habitual excessive drinker, and his final de-

bauch had lasted three days. He had had three attacks of urethritis in the course of fifteen years, and had suffered retention of urine three times during the twelve months prior to his admission to the hospital. Once the bladder was relieved of its burden of urine by suprapubic capillary puncture and aspiration. There were two dense, narrow strictures, one in the phallic and one in the perineal region of the urethra. Very soon after admission, he was successfully catheterised with a filiform whalebone bougie and tunnelled instruments, beginning with No. 2 and carrying the dilatation to No. 6, when twenty-eight ounces of clear urine flowed through the catheter; this being about two-thirds of the contents of his distended bladder. An olivary bougie No. 5 was then passed and retained twenty-four hours—for continuous dilatation—the urine oozing beside the bougie after a few hours. The usual dose of ten grains of quinine was administered. Dilatation of the strictures was made every second day, and at the fourth and fifth sittings No. 8 was easily introduced. In the meantime the patient urinated in a good stream at the regular intervals. Dilating instruments were then used every fourth day until No. 13 could be readily passed. He was advised to continue this treatment indefinitely, and was discharged at his own request, on the 27th of May.

12. The writer has employed this method of treatment in upward of five hundred difficult cases of urethral stricture, with a degree of success that warrants an earnest recommendation of its more general use. In the great majority of these cases no anæsthetic agent was used, because the operation is not very painful, because it is of short duration, because of the danger of rupture

of the distended bladder during the struggles of the semi-conscious patient in the second stage of anæsthesia, and because of the ill-effects of some anæsthetics—particularly ether—upon the kidneys. The mortality after this mode of dilating and divulsing strictures has not exceeded three per centum, and has been due mainly to advanced disease of the bladder, ureters, and kidneys.

13. In retention of urine due to extremely narrow strictures, puncture of the bladder, with the ordinary trocar above the pubes or through the rectum, has too often been employed and should be discarded mainly on account of its well-known dangers. The substitution of capillary puncture with immediate aspiration of the urine was indeed an important advance, since, with less risk, it gave the needed temporary relief pending the treatment of the stricture. In cases of great urgency, the tapping of the urethra behind the stricture is far preferable to rectal or supra-pubic puncture, particularly by the modern improvement of the old methods of Foubert and Molins, made by Edward Cock,* of London, of which the following is a brief abstract.

14. The instruments required for the performance of Mr. Cock's operation are: "A broad double-edged knife, with a sharp point; a large probe-pointed director; and a female catheter. The patient being placed in the lithotomy position, the left forefinger of the operator is passed into the rectum so that its tip may rest at the apex of the prostate. The knife is then boldly plunged

*On the means to be adopted for establishing a communication between the bladder and the exterior of the body when the urethra has become impermeable. By Edward Cock, etc., Senior Surgeon to Guy's Hospital. Guy's Hospital Reports, Vol. XII, p. 267.

into the median line of the perinæum and carried in the direction of the tip of the finger at the apex of the prostate; at the same time, by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within half an inch of the anus. The knife should not be withdrawn in its progress toward the apex of the prostate, but its onward course must be steadily maintained until its point is in close proximity to the tip of the left forefinger. When the operator has fully assured himself of the relative positions of his finger, the apex of the prostate, and the point of the knife, the latter is to be advanced with a motion somewhat obliquely either to the right or to the left, and it can hardly fail to pierce the urethra. If in this step of the operation the anterior extremity of the prostate should be incised, it is of no consequence. In this operation it is of the utmost importance that the knife be not removed from the wound, and that no deviation be made from its original direction until the object is accomplished. If the knife be prematurely removed, it will probably, when reintroduced, make a fresh incision and complicate the desired result. It will be seen that the wound, when completed, represents a triangle; the base being the external vertical incision through the perinæum, while the apex is at the anterior extremity of the prostate. This shape of the wound facilitates the next step of the operation. The knife is now withdrawn, but the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound, and guided by the left forefinger, enters the urethra and is passed into the bladder.

The finger is now withdrawn from the rectum: the left hand grasps the director, and along the groove of this instrument the catheter is slid until it enters the bladder. It now only remains to draw off the urine and to secure this catheter in place."

15. Some queer procedures have been employed, to ease the distended bladder, both in the way of urethral catheterism and vesical puncture, by the sufferers themselves. Hollow reeds, hard wood fashioned like bougies, iron wires, glass tubes, and many other strange contrivances have been used with more or less hurt to the parts even when relief has come. The supra-pubic opening of the gorged bladder was once effected by a seafaring man who plunged a sharp knife in the median line a little above the pubes. There followed a great gush of urine which gave present relief, but much trouble came from the effect of urinary infiltration of the adjacent connective tissues, but, notwithstanding the consequent grave disturbances, the patient recovered. Another sailor, for the purpose of relieving his greatly distended bladder, used a marlinspike which he passed into his own rectum and thrust into the base of the bladder, giving free vent to the pent-up urine, and he, also, recovered! A still more remarkable case, recorded by Dr. Ringnell,* of Minneapolis, is that of a man, sixty-four years of age, who had long suffered from a urethral stricture and several consequent retentions of urine, the last occurring after a debauch. For relief, he resorted to the extraordinary expedient of filling the urethral canal, from the stricture to the meatus, with gunpowder which he set

*The Journal of the American Medical Association, December 24, 1904, p. 1973.

off with the idea of blasting the stricture. The effects of the blasting were the shattering of the urethra, hæmorrhage, extravasation of urine, gangrene of the parts, sepsis, and death on the fourth day!

16. Among the ill consequences of neglected retention of urine due to urethral stricture, are: perineal and scrotal abscesses followed by urinary fistulæ; extravasation of urine with loss of substance from the ensuing gangrene of the parts; and cystitis, ureteritis, and pyelonephritis.

17. Abscess formation in the scrotum and perinæum is generally due to the leakage of a few drops of urine through some minute ulceration of the attenuated mucous membrane of the dilated urethra behind narrow strictures that cause incomplete retention with cystitis and painful dysury. The abscess generally points to the surface and opens spontaneously if not early incised; the result being a fistula discharging purulent urine. Sometimes, however, a peri-urethral abscess is developed and opens both externally and in the urethral canal and thus establishes a urinary fistula, or the abscess may form in the tract of a false route.

18. The analysis of eighty-five cases of very narrow urethral strictures shows that twenty-four were complicated with scrotal and perineal abscesses followed by fistulæ, nine of which were single and the rest multiple, with much induration of the adjacent parts. In two of these cases there was complete obliteration of the urethral canal at the seat of stricture; all the urine escaping by the perineal fistulæ.

19. Urethral fistulæ in the perineal region have sometimes been mistaken for anal fistulæ and treated as such,

with the effect of producing urethro-rectal fistulæ. This error in diagnosis is not strange since the cloacæ of some urinary fistulæ appear very near the anus, or in the ischio-rectal region. But such an error is avoidable if the surgeon first carefully explore the urethra; the discovery of a narrow stricture indicating the real source of the fistula.

20. Restoration of the normal urethral caliber, in the great majority of narrow constrictures, is ordinarily sufficient to secure the permanent closure of the complicating fistulæ.

21. In cases of strictures of the perineal region, when the canal is dilated and attenuated behind a tight constriction, any sudden or violent effort of the patient for spontaneous relief is likely to cause a rupture of the ampulla and to force out a large volume of urine to infiltrate the loose connective tissue of the perinæum, scrotum, penis, hypogastrium, and sometimes even the loins and thorax. Such a condition is ordinarily designated rupture of the urethra and extravasation of urine.

22. The often uncontrollable fit of straining causing the rupture of the urethra is generally followed by a temporary sensation of relief; the patient believing that the obstacle has yielded and that urination is accomplished, but to his surprise there is no external moisture, and his touch and sight reveal a rapidly increasing tumefaction of the scrotum and penis. This is succeeded by depression, nausea and faintness. The effect of the extravasated stale urine is so fatal to the connective tissue that, within thirty-six hours, the gases evolved from the decomposed urine and from the necrosed tissues greatly augment the scrotal swelling. The skin

over the implicated parts is tense, dusky red, and soon gangrenous unless prompt surgical aid had already come. Otherwise the whole scrotum sloughs away and the testes are left bare. The appearance of a gangrenous patch on the glans penis is an ominous sign which indicates infiltration of the spongy body and forbodes a fatal issue. The sufferer is in a state of muttering delirium, his pulse is very frequent and thready, his respiration labored, his tongue dry, and his countenance pinched and ashy. His septic condition may then be so profound as to place him beyond the power of medication. But when, within eighteen or twenty hours after extravasation of urine, he has had the advantage of the surgeon's skill, his chances of recovery are much increased.

23. The treatment in such cases must be prompt and energetic, for the longer the delay the worse for the patient. The first indication is to relieve the tension of the parts involved, next to give free vent to the extravasated urine and thus limit the local necrotic process. This is accomplished by a free incision in the median line of the scrotum and two or three equally free incisions either side, one incision on each side of the swollen teguments of the penis, and lastly a central longitudinal perineal cut followed by division of the strictured part of the urethra. The writer has so often had reason to be satisfied with the result of dividing the stricture immediately after making the perineal incision that he cannot too strongly recommend its practice. Anæsthetics are not necessary, for the reason that the sensibility of the parts is so nearly abolished in the majority of cases of extensive urinary infiltration.

After the urethral incision a catheter is passed through the wound, the bladder emptied and washed, and the external parts thoroughly cleansed and wrapped in moist antiseptic gauze to be changed at least thrice daily until all sloughs have been removed; no catheter having been left in situ. In the meantime, catheterism every third day should be employed to keep patent the strictured canal. The suppuration from the large exposed surface is generally profuse and cicatrisation of the wounds very slow. Hence the necessity of supplementing the surgical with a judicious medical and hygienic treatment designed to sustain the vital powers and hasten convalescence.

XIII

RETENTION OF URINE IN ELDERLY MEN

1. Men advanced in years are subject to two forms of urinary retention: the acute, sudden; and the chronic, slow, insidious. The first may be due to a narrow urethral stricture, to the arrest of gravel in the urethra, to impacted prostatic concretions, or to acute swelling of the prostate; the second form generally being the outcome of prostatic obstruction from chronic enlargement.

2. By acute retention is meant a sudden hinderance to the expulsion of urine from the distended bladder. It is characterised by great pain and an almost intolerable sensation of vesical distension and of scalding in the urethra, and by a constant desire to urinate which seems to be on the point of without being gratified.

3. Of the several excitants of acute retention, it is the last which will now be examined, namely, the swelling of the prostate that sometimes occurs among elderly men who have little or no hinderance to normal urination, and even among those who are sorely inconvenienced with true incontinence of urine. Its mechanism may be described as follows: After exposure to cold, or soon after venereal or bacchic excess, the pelvic vessels become so gorged with blood that the prostate swells to the extent of occluding the vesical orifice. This sudden

engorgement is soon followed by exudations which do not always vanish. Resolution is often very slow and even fails, and the acute retention may thus pass into chronic retention of urine.

4. Acute retention of urine is ordinarily preceded by dysury for an hour or two. Urination is unduly frequent, scanty, irregular, and accompanied with scalding pain in the whole urethra, until strangury occurs, then the urine, mixed with mucus and blood, escapes only in drops at each spasmodic contraction of the bladder whose neck is finally so blocked by the œdematous mucous membrane that no more urine can be expelled despite the most violent straining which favors the escape of fæces and sometimes even causes prolapse of the rectum. The sufferer's face is flushed, his skin, at first hot, dry, and harsh, is soon bathed in profuse sweat which later has a strong urinous odor, his thirst is great, and his body temperature steadily rising. It is during the first twenty-four hours that the patient's sufferings are most intense. The distressful strangury does not cease until the bladder has become inert from over-distension, but there is still, on the second day, much hypogastric and lumbar pain which ceases only after relief of the bladder. Toward the close of the second day the urine begins to dribble, and this occurrence is the occasion of a fatal delusion on the part of the patient and friends who unfortunately imagine that spontaneous relief has come as last, when in truth the urine is still accumulating in the bladder, only a little slobbering out from overflow. The consequence of this misinterpretation of a mere symptom is failure to invoke medical aid until the misguided friends deem it proper to repress

what they wrongly believe to be a superabundant flow of urine. Meanwhile the patient lapses into a muttering delirium; his incoherent utterances being further obscured by the extreme dryness of his tongue and mouth. The secretion of urine is lessening, and may be soon abolished, although the distended bladder contains four or five pints of urine. In some cases the physician is not summoned until many nauseous, useless, and often hurtful nostrums have been administered.

5. In the management of acute retention of urine, to temporise or to rely solely upon the use or oral medicaments in any case, is to prolong the suffering of the patient or even to imperil his life. Therefore, having informed himself of the circumstances connected with the present attack of urinary retention, and having made a preliminary examination of the case, the physician selects a suitable soft catheter and forthwith introduces it, allowing the urine to flow very slowly by closing the distal end of the catheter every few seconds. If called during the first twenty-four hours, he may empty the bladder at one sitting of an hour, but if on the second day, he should draw off gradually not more than one-third of the bladder contents, and after this, once every two or three hours, introduce the catheter and allow half a pint of urine to escape, until in the course of two or three days the bladder is finally emptied, or he may leave in the catheter with its distal end closed, to be opened only every two hours for the withdrawal of eight ounces of urine. The reason for these precautions is that the too precipitate evacuation of an over-distended bladder is often followed by distressing and dangerous changes in the mucous membrane, such as rupture of

its capillaries succeeded by profuse hæmorrhage, general cystitis, polyury, etc.

6. The after-treatment should accord with the special necessities of the case. Of course the use of the catheter is not abandoned until the patient is able to empty spontaneously his bladder which should not again be allowed to become over-distended. If the prostatic swelling does not vanish or even causes only a slight impediment to complete spontaneous vesical evacuation, the periodic catheterism should be continued as long as there is residual urine, and cleansing irrigations used daily.

7. The second or chronic form of urinary retention, so common among elderly men suffering from prostatic enlargement, needs to be studied with special reference to its diagnosis and treatment.

8. By chronic retention of urine is meant a gradual and slow hinderance to the expulsion of urine from the bladder. Its characters are not generally perceived by the patient, and are not always manifest even to the physician, partly because this retention of urine does not become complete for many weeks or months, or may never become complete. When incomplete it is at first characterised by much irritability of the bladder, which is constantly wrestling against the obstruction in striving to force out the urine; but this struggle lessens in the course of a few months when the sensibility and contractility of the bladder are already impaired, as evinced by less painful, less urgent, and less frequent urination, and by the stream of urine being small, feeble, frequently interrupted, and recurring in a succession of drops. When the retention becomes complete it is characterised

by the patient's inability to force out any urine. It is plain that chronic retention of urine is the outcome of gradual, progressive closure of the urethra or urethro-vesical orifice by unequal enlargement of the prostate which is the most common cause; and that, in elderly men, this chronic retention is due also to narrow urethral strictures of long standing, the morbid changes in the bladder being much the same as those due to the chronic retention arising from prostatic obstruction. Stone in the bladder, too, by causing cystitis with spasmodic, and later, permanent contracture of the vesical neck, is sometimes the occasion of chronic retention. Before Mercier's time, no physician had ever accounted for the stagnation of urine which often continues after the removal of calculi by lithotripsy and aspiration. Tumors of the bladder and other excitants of cystitis with contracture of the vesical neck are indirect causes of chronic retention of urine. Finally, an untimely relieved acute retention from sudden swelling of a very slightly enlarged prostate becomes chronic owing to failure of resolution of the acute engorgement.

9. Of the symptoms of chronic urinary retention due to prostatic enlargement, it may be said that they are seldom recognised by, and are often misleading to, the patient and sometimes even to the medical attendant. In the earlier stages of prostatic enlargement there is, to the patient, no evidence of its existence and he fails to interpret any changes occurring in his mode of urinating. These changes have been so gradual that he can recall the date of their beginning only after his attention is directed to the nature of normal micturition:

then after much cross-questioning he finally admits that, for several months prior to the advent of distinct and increasing changes which, for two or three years past, might well have caused him some anxiety, the jet of urine had not been propelled with its wonted vigor, and that dribbling followed the close of voluntary urination; but he had ascribed this to advancing age, had given the subject no further thought, and had not for a moment supposed that it could be the incipient stage of a coming serious infirmity. He would then say that, for the last twelve months or thereabouts, the inconvenience in question had increased very noticeably, that he had been urinating with undue frequency by day and by night, that, at first, he was never satisfied with the amount that came away, for the desire to expel more urine was as urgent as if he had passed none, but that of late he had ceased to suffer from dysury. Such, in brief, is the account ordinarily obtained from intelligent patients after a lengthy cross-examination. The last sentence in the foregoing abstract of the history of the sufferer's illness shows clearly that the bladder had already lost all power to wrestle with the obstacle to urinary expulsion and that inertia of its muscular coat was imminent. From that moment a little urine was passed, mainly by the aid of the abdominal muscles, every hour or half hour, and at last began to slobber out. These phenomena are very often misinterpreted by the patient who believes that he is passing too much water and that means must be taken to repress this supposed undue flow. When, for this purpose, he applies to the surgeon, he is not a little surprised when told that the undue in-

voluntary flow indicates retention rather than incontinence of urine.*

10. One of the prominent symptoms of chronic retention of urine is a lumbago or a sciatica solely on account of which patients often seek medical treatment, declaring that all is right with the urinary apparatus and declining at first to submit to its exploration with instruments; but when, immediately after passing spontaneously four or five ounces of urine, the catheter is introduced and a pint or more of urine is drawn off, they express some surprise, but even then it is not easy to convince them that the really serious trouble arises from the urinary retention, and that the sciatica is only one of its remote effects. It is wise, in the management of such a case to strive to relieve medicinally the distress incident to the lumbago or sciatica while special attention is directed to the removal of the real cause.

11. The progress of unrelieved chronic retention of urine is ordinarily slow and is somewhat as follows: The patient who has long been tormented by frequent but incomplete acts of urination and who has obstinately refused surgical interference, or, from ignorance of the real nature of his ailment, has never sought any aid, learns when too late that he has been misled into depending solely upon internal medication. From that moment he loses all hope of recovery, becomes restless and sleepless owing to constant dribbling of urine; his appetite vanishes, and his functions are all disturbed. Irritative fever supervenes from the existing cystitis and

* The profession owes a debt of gratitude to Dr. Mercier for having correctly interpreted this phenomenon which, before his teachings became known, was generally regarded as incontinence of urine.

the steadily accumulating purulent, slimy urine. He has a dull lumbar pain due to distension of the ureters and renal pelves; his bowels are filled with fæces and gas; his tongue is parched, his speech is incoherent; his skin is dry at first, and is finally covered with cold sweat, partly as a result of general relaxation, partly as a last effort of nature to eliminate effete material. Very little urine is now passing away, although the bladder is still full; the secreting power of the kidneys steadily lessens until it ceases entirely. He then sinks into a state of muttering delirium, from which, with no little difficulty, he is roused, and dies from the combined effects of urinous, purulent, and fecal intoxication. The lesions ordinarily found, post-mortem, in such cases are: A well-marked vesico-urethral obstruction; a columnar, thickened bladder containing a quart or two of fetid, slimy urine, and indicating long-continued inflammatory action; the ureters dilated to two or three centimeters or more in diameter; the renal pelves distended with slimy urine to three or four times their normal capacity, and the kidneys themselves in a state of interstitial inflammation with many abscesses. Another common lesion of the bladder consequent upon retention of urine is its sacculation which will be examined under the head of bladder sacculation.

12. The diagnosis of chronic retention of urine is often very difficult, and sometimes is never made. The reasons for the difficulty of, and the failure in, diagnosis, will appear in the subjoined annotations, as will also fair methods of arriving at a correct diagnosis. But first, a word may be said of the wrong usage, by old authors, of the word suppression of urine, really signify-

ing abolition of the action of the kidneys, when they meant retention of urine in the bladder. Even in the nineteenth century an unwarranted distinction in terms has led to grave error, as in the case of such high authorities as Civiale and Phillips, who both declared that stagnation of urine from inertia of the bladder, and retention of urine should not be confounded. Phillips insisted upon this distinction, which he regarded as very important, saying substantially that stagnation of urine is always the result of a diminution in the expulsive power of the bladder, while retention of urine is always caused by a material obstacle, such as is produced by an enlarged prostate or any other permanent obstruction. However, in the very next sentence he called attention to the fact that stagnation is one of the sequels of retention of urine; meaning, presumably, acute retention. Is not stagnant urine in the bladder retained urine, and is not the urine stagnant in chronic retention? The one, of course, implies the other, and either term may be used, but chronic retention, because opposed to acute retention, seems preferable. As to the question why should such designations as acute and chronic be used in treating of retention of urine, the answer is that it is because the distinction is not only convenient and logical, but of much practical import, and that the difference between the two is sharply enough marked to warrant the use of the qualifyers. The one being sudden in its invasion and extremely painful principally in the affected region; the other gradual, insidious, and accompanied with dull, obscure pains, often referable to distant parts.

13. To aid the beginner in the differential diagnosis of acute and chronic retention of urine, the main dis-

tinctive features of each variety are here described side by side.

Acute retention manifests itself suddenly, becomes complete in the course of a few hours, and from the first moments of its occurrence, the patient is conscious of its existence by very great pain and constant desire to urinate.	Chronic retention is a slow and insidious process by which the bladder often becomes gradually over-distended without the patient's being aware of the fact. This retention may not become complete for weeks or months, or it may always remain incomplete.
In acute retention, within the first forty-eight hours, the bladder preserves its full sensibility and contractile power, except in cases of injury of the spine followed immediately by paralysis.	In chronic retention there is always loss of power of contraction of the bladder, with impaired sensibility.
Acute retention is always the result of a sudden obstruction to the flow of urine either at the vesical orifice from acute engorgement of the prostate as well as from spasmodic contraction of the vesical neck; or in the urethra, owing to swelling near a narrow stricture, to the lodgement of a plug of muco-pus in the narrowed part of the canal, or to the impaction of a calculus.	Chronic retention is due to gradual, progressive but often incomplete closure of the vesical orifice by an enlarged prostate; to inertia of the bladder which has not been the outcome of prostatic obstruction, but of a urethro-vesical muscular valvule, of a stricture, of a stone, or of a tumor of the bladder; to neglected acute retention; and to such disease or injury of the great nervous centres as may destroy or impair the innervation of the hollow organs.
In acute retention, the closure of the vesical orifice is due to congestion and consequent œdematous swelling of the mucous membrane.	In chronic retention the incomplete obstruction of the vesical orifice proceeds from gradual encroachment by either lateral lobe or by the increasing median part of the prostate.

In acute retention there may or may not be much prostatic enlargement.	In chronic retention there is decided prostatic enlargement either of the lateral lobes or of the median portion; except, of course, in cases of inertia from a muscular valvule, from stone, from stricture, etc.
In acute retention the congestive swelling is often the consequence of exposure to cold, or of over-indulgence in eating, drinking, or venery.	Chronic retention does not generally arise from exposure to cold, etc., though it is sometimes the outcome of acute retention.
Acute retention is always immediately preceded by dysury and strangury and accompanied by violent and distressing straining.	Chronic retention is not always preceded by dysury and strangury, as both may have begun weeks or months previously, and it is not accompanied by violent straining. Often there are no rational signs of its existence.
Acute retention very soon becomes complete—not a drop of urine flowing—then in the course of two days it is again incomplete—the urine dribbling involuntarily night and day.	Chronic retention is for a long time incomplete; urination being voluntary, but in a small weak stream which, every few seconds, is suddenly interrupted and then succeeded by twenty or thirty drops. This kind of urination may continue to the last, or the retention may become complete in a few weeks or months, to be finally incomplete with involuntary dribbling which at first occurs only at night or during sleep.
In acute retention the overdistended bladder forms, in the hypogastric region, a prominent, hard, tense, rounded tu-	In chronic retention the bladder is soft, slack, yielding, painless, and can not be mapped out. Its palpitation gives the idea of

mor which is very tender to the touch and easily mapped out.

its being a flaccid bag containing a fluid by which it is not distended; often leading the inexperienced to think that the fluid is in the peritoneal cavity and not in the bladder.

Acute retention of urine may be, although it is not necessarily, accompanied by cystitis.

Chronic retention is always accompanied by cystitis.

14. The distinctive features of acute and chronic retention of urine above noted have clearly warranted the separate consideration of the two varieties from pathic, therapeutic, and prognostic points of view.

15. Grave errors in diagnosis are occasionally made in cases of extreme distension of the bladder from neglect to use the catheter as a means of diagnosis, for in elderly men the urine sometimes accumulates so slowly and gradually that the vesical distension causes little or no pain, or the slight pain is attributed to something else, and in the course of some weeks or months, this distension so increases as to mislead the unwary. Such cases have been mistaken for ascites, for abdominal tumors connected with the omentum, intestines, liver, or kidneys; for hydatids, for hydronephrosis, and even for fecal impaction. A reputable physician, although aware that his patient was affected with prostatic enlargement, thought the great abdominal distension for which the sufferer sought relief must be due to a malignant growth in the cavity of the abdomen, and paid no attention to the bladder because the patient was able to urinate; but in a few days the use of a catheter became imperative, and as soon as a sufficient amount of urine was drawn off, the supposed malignant abdominal tumor

was no longer in question. A typical case, illustrative of fatal errors in diagnosis and treatment, may be worth citing. The patient was seventy years of age, of slight build, and somewhat emaciated. Three years before applying for treatment he had noticed, in the hypogastric region, a marked protuberance which he ascribed to constipation, although he urinated with increased frequency during the day and several times at night; always insisting that the real trouble was the constipation for which he had consulted several physicians. He had been, for twelve days, under the care of the physician with whom the writer saw him in consultation, and his case had been regarded as one of cancerous or of hydatid disease, by this and another physician, but the distinct fluctuation afterward discerned in the tumor led both to believe rather in the existence of hydatid cysts than of cancerous disease. So, on the fourth day, the attending physician made a puncture of the tumor five centimeters below the umbilicus, with a small trocar, and, by aspiration, drew off four liters and three-quarters of a light colored fluid. On microscopic examination of the sediment, none of the hooklets characteristic of hydatid cysts were found, but there was an abundance of uric acid crystals, pus cells, and vesical epithelium. The trocar had entered the bladder which had risen high up above the umbilicus and had projected so far forward as to suggest the existence of a tumor of abdominal rather than of pelvic origin. The catheter was not used until twenty-four hours after the sudden removal by aspiration of the contents of the greatly over-distended bladder, when four pints and a half of bloody urine came away. Although this polyuria had so quickly supervened, the

vesical hæmorrhage was unchecked; the catheter being passed but once in the twenty-four hours, each time drawing two liters and a quarter of bloody fluid. At the end of four days the quantity of urine began to decrease. It was then that the writer first saw the patient and advised evacuating catheterism every six hours, but such was the deplorable condition of the sufferer that none but the most unfavorable prognosis was warranted; however, he lived two weeks longer. The only diseased organs found at the necropsy were the urinary, from the prostate which was the primary cause of the urinary retention to the consequently damaged kidneys. This is a fair example of the outcome of neglected chronic retention of urine treated on the basis of an erroneous diagnosis. The case is also a good illustration of two ill results of the precipitate evacuation of the over-distended bladder, namely, excessive polyury and profuse hæmorrhage from the vesical mucous membrane.

16. Whilst the proper interpretation of the symptoms is of unquestionable value in the diagnosis, the crucial test of chronic retention must rest solely with the right use of the catheter by which alone are eliminated other possible conditions; for if, immediately after the patient has passed all the urine he can expel voluntarily, half a liter or more of fluid is drawn off through a catheter, there can be no doubt of the abdominal distension being due to accumulation of urine. The fatal errors in diagnosis, to which reference has just been made, could not have occurred had the catheter been employed early in the examination of the patient.

17. The surgical treatment of chronic retention of urine should consist in drawing off the offending urine,

in relieving the existing cystitis, and in removing the obstacle to spontaneous urination.

18. When the retention is due to a urethral stricture, the canal should be dilated, divulsed, or incised at the seat of its narrowing in order to permit the passage of a catheter through which the urine may flow. The bladder, having been emptied in due time, is then daily irrigated until the urine is free from pus. Meanwhile, periodic dilating catheterism is employed to guard against recontraction of the stricture.

19. Chronic retention from spasmodic contracture of the vesical neck due to chronic urethritis is, of course, relievable by the catheter, but the urethro-cystitis demands active treatment by appropriate irrigations* and subsequent dilatation of the membranous and prostatic regions of the urethra. But when the contracture is permanent, internal or even external incision of the vesical neck is needed to effect a complete cure.

20. When chronic retention consequent upon prostatic enlargement is early discovered and the stagnant urine drawn off twice daily, such relief follows as to save the patient from the distressing and dangerous effects of infective cystitis and for a long period to enable him to attend to his ordinary duties without discomfort as soon as he is taught auto-catheterism and the care of his catheters which he continues to use night and morning. But when the obstruction to urination becomes complete by the slowly and steadily increasing prostate, catheterism is imperative five or six times daily. Through this simple local treatment many elderly men have enjoyed fair general health for five, ten, and in some cases,

*See Chapter XXII, Bladder Contracture.

twenty years, and these very encouraging results have been due chiefly to scrupulous care and cleanliness of the catheter and to the skill attained in its use.

21. Chronic retention of urine of a few months' standing is quite amenable to treatment, especially in well-nourished patients who are otherwise in fair physical condition; but in those who, for two or more years, have been neglected and whose general health is much impaired, the prognosis is ordinarily bad, for after this lapse of time the ureters and kidneys are seriously damaged, and the most that can be done is to mitigate suffering.

22. In the treatment of a case in which there is every probability that the kidneys are not hopelessly involved, if the bladder has been in a state of distension even for several months, the first step is to draw off the urine; but this must be done with great care, very slowly and by degrees. In 1876 the writer adopted a plan of operation by which the whole of the stale, offensive contents of the long-distended bladder can be removed at one sitting. In order to make the modus operandi intelligible, let a case be supposed in which the bladder is distended so that its fundus rises above the level of the umbilicus. A catheter is passed and half a liter of fetid, purulent urine is drawn off. Immediately a quarter of a liter of any unirritating antiseptic solution is thrown in; then another half liter of urine is allowed to flow out slowly through the catheter, and a quarter of a liter more of the solution is injected. There is already half a liter less of fluid in this bladder and what remains is mixed with a disinfectant. Afterward, for every quarter liter of diluted urine drawn a quarter of a

liter of the solution is injected, until the fluid that escapes from the catheter is perfectly clear. Then, once every four hours, a quarter of a liter of the clear contents is removed until the bladder is entirely empty, which may take two, three, or four days.* Then twice daily irrigations, with the same solution, should be made to relieve the cystitis. The catheter to be employed four times each day, unless the patient is able to pass spontaneously a sufficient quantity of urine; in which case two or three daily evacuating catheterisms may suffice. Thus is prevented the serious vesical hæmorrhage which inevitably occurs from the precipitate evacuation of the distended bladder; at the same time that the organ is freed from stale, purulent, slimy, irritating urine. It is of prime importance to persevere in the daily artificial evacuation of such bladders and to thoroughly irrigate them, for, unless this be done, the cystitis not only continues, but gives rise to the formation of phosphatic concretions which increase in size rapidly and after their removal are soon reproduced, and when lodged in the pouches are of very difficult access.

23. Respecting catheters, the answer to the commonly asked question, "What kind should be used for the relief of retention of urine due to prostatic enlargement?" is that no one kind or form of catheter can be regarded as THE CATHETER. The same sort of catheter does not answer equally well in all cases any more than the same sized glove can fit all sized hands. The operator must

*The description of this process, which will bear repetition, will reappear under the head of Bladder Hæmorrhage, note 15, Chapter XXIII.

endeavor, by rectal exploration, to determine the degree of enlargement of the prostate, and then explore it by way of the urethra with a flexible curved web-catheter or an elbowed, a double-elbowed, or a crutched catheter. When the urethra is free from stenosis or from contracture, one of these forms, in the majority of instances, is more than likely to reach the bladder.

24. The first-named catheter, woven upon a curved mould, is well adapted to cases of moderate supra-montanal enlargement and also to cases of prostatic valvules. The elbowed catheter of Mercier is particularly well adapted to cases of intra-urethral growths, of unilateral enlargement or of unequal development of both prostatic lobes, but is also successfully used in ordinary urethro-vesical barriers. The double-elbowed catheter, is adapted to cases of enlargement of the superior isthmus together with supra-montanal increase which causes much depression of the floor of the prostatic sinus. The crutched catheter, much more angular than the elbowed, answers well in cases of great enlargement of the supra-montanal region; the heel instead of the point of the instrument coming in contact with and gliding over the obstacle.

25. The soft vulcanised India-rubber catheter is ordinarily the safest in the hands of the inexperienced, and for auto-catheterism, but its long employment is not advisable. The security felt by the patient is often a source of danger, for he is soon heedless of the precautions enjoined by his adviser, and suffers in consequence. Owing to the patients' ventures with, and their over-confidence in these easily managed instruments, physicians are frequently called to extract from the bladder

fragments of or entire rubber catheters. But, aside from these accidents, the urethra is often greatly irritated by the rubber catheter, not on account of the material itself but of the carelessness, boldness, and undue frequency of its use, which all come of its easy introduction. Painstaking, prudent and intelligent patients soon acquire sufficient skill in the use of any of the several pliable catheters and learn to keep them in good order. An important advantage of the rubber catheter is that it can be kept indefinitely in an antiseptic aqueous solution without injury to its structure.

26. The size of catheters is worthy of special notation. To the question, "Should they be small or large?" the answer is that they should be neither, but should be adapted to the caliber of the particular urethra to be catheterised. Many of the patients who practise auto-catheterism have a predilection for small catheters such as Nos. 4, 5, 6 of the English scale, and labor under the wrong impression that they are the safest and give less pain than instruments of average caliber. In truth, to the use of small catheters, particularly when rigid, may be attributed some of the wounds of the mucous membrane and the frequent attacks of orchitis from which these auto-catheterists suffer. The safest and best sized instruments for general use are assuredly the pliable catheters that, without unduly stretching, moderately fill the urethra, such as an instrument of six millimeters in diameter. In case neither can be passed without giving pain, it is wise to subject the canal to a short course of dilatation with steel sounds to 8½ or 9 millimeters; the effect of such dilatation being to restore the suppleness of the urethra. Otherwise the

state of contracture continuing, it will be impossible later to use smaller catheters without increasing the trouble and causing frequent hæmorrhages and other mischiefs. In cases of false routes the small catheters are apt to lodge therein and so fail to reach the bladder. It is then necessary to have recourse to instruments of a sufficiently large caliber to prevent their entering the false route.

27. The length, too, of the catheter has its importance. In the majority of cases, catheters of twenty-two or twenty-five centimeters answer well for simply drawing off urine, while in extreme cases, and for special purposes, as will be seen later, greater length is required. The ordinary soft catheters, either web or rubber, average twenty-two centimeters in length, and this is necessary for the convenience of patient and physician when bladder irrigations are to be made; the average urethra being twenty-one centimeters long.

28. Metallic catheters should not be used ordinarily for the relief of urinary retention, for the reason that they are so apt to tunnel their way out of the right passage even when used with care. This accident often occurs in those cases of retention of urine due to inordinate development of the supra-montanal region ("third lobe") of the prostate, particularly when the so-called prostatic catheter is employed. The hurts inflicted by this or any other rigid catheter occur at or near the bulbo-membranous junction of the urethra, or in the prostatic region. In the first instance, undue force used in the operation sends the point of the instrument through the lower wall of the urethra, and the flow of blood instead of urine shows that the bladder has not been entered.

In the second instance, the point of the catheter has made a breach in the prostatic sinus wherein it is immovably fixed, and blood but no urine flows. In these circumstances, the custom had been to puncture the bladder with a trocar, until a simpler method was devised.

29. Supra-pubic capillary puncture of the bladder immediately followed by aspiration of the urine was introduced to the profession, about thirty-five years ago, by Dieulafoy, and the novelty soon became the fashion. Many successful cases were reported, and this method of puncture and aspiration was to be THE operation in retention of urine. However, it soon became evident that too much had been claimed for capillary puncture, and in a few years the vogue of the process was on the wane; its successes and accidents having been duly weighed. At present, more discrimination is exercised in its employment, and it is resorted to, only for the temporary relief of extreme vesical distension, once or twice and not, as formerly, ten, twenty, or thirty consecutive times in the same case. Its proper application is of unquestionable value, but its careless or intempestive use cannot be too sternly censured. The consequences of the escape of a few drops of urine in the prævesical connective tissue have been so disastrous in many cases as to deter cautious physicians from employing this method of relief except in cases of the greatest urgency. It is difficult to conceive why puncture of the bladder for the relief of retention of urine due to prostatic enlargement should have been so extensively practised during the nineteenth century, when simpler and much safer and more effective means had been de-

vised and employed, as far back as the eighteenth century, by Hey, of Leeds, and the middle of the nineteenth century by Mercier, of Paris.

30. Hey's excellent device is as follows: A curved web-catheter in which a metallic stylet has been inserted is introduced down to but not into the false route, and with the right hand, the stylet is withdrawn about one inch at the same moment that, with the left hand, the catheter is gently pushed onward. The increased curve thus obtained allows the point of the instrument to override the mouth of the false route and enter the bladder. This mode of operating has answered well in many cases of urinary retention complicated with false routes in the perineal as well as in the prostatic region of the urethra.

31. Mercier's method was published, during the year 1850, in the *Union Medicale*, wherein he gave an account of his instrument which he named the invaginated catheter, and which he had employed with great success in cases of retention of urine when the bladder was inaccessible to ordinary catheters by reason of prostatic false routes. Descriptions with drawings of the instruments appeared in other journals and in divers surgical works, but little heed seems to have been otherwise taken of this precious device. It may be fairly stated that in ninety-five per cent. of cases of prostatic false routes the invaginated catheter can be successfully applied. The instrument, as now made, consists of two catheters; one metallic, the other non-metallic. The first or female part is a thin-walled silver catheter 6½ millimeters in diameter, twenty-seven centimeters long, very slightly curved, and having in the concavity of its

curve, at about thirteen millimeters from the point, an oval eye sixteen millimeters in length and about five millimeters in breadth. From the vesical extremity of the eye is an inclined plane which is lost in the floor of the opening at the distance of about ten millimeters, serving to tilt up the point of the male part. This male part is a straight flexible but firm web-catheter four and one-half millimeters in diameter, fifty centimeters long, fitting loosely in the lumen of the female part and having a small single lateral eye three millimeters from its point. The way to use the invaginated catheter is to insert the male into the female part, as far in as the eye of this part, then to pass the instrument into the urethra as far as the obstacle and engage the point of the metallic or female part in the false route and finally to project the male part which will override the blocked up false route and enter the bladder. In case no urine should flow it would be owing to closure of the eye of the male part by a blood-clot which may be forced out by the injection of a little water through the male catheter. The female part can then be withdrawn and the male left in position as long as may be needed. This is the reason for the increased length of the male part. Originally, a catheter of ordinary length was used, and when it was desired to leave it in situ it was pushed a short distance into the female part and steadied by another catheter until the female part could be entirely withdrawn.

32. The management of ordinary cases of chronic retention of urine with or without false routes may be summarised as follows: Catheterism having been successful, only a part of the stagnant urine should be drawn off, and the bladder not completely emptied for two or

three days and sometimes not for a week, but the quantity of retained urine should be lessened every day. When finally emptied, the bladder should be daily washed. In many cases, however, it is not wise to begin at once with irrigations or to use them as often as once a day, for bladders that have long contained purulent, slimy urine do not at first tolerate the contact of limpid fluids of low specific gravity. It is therefore necessary to increase the density of the water used for their irrigation in such and, indeed, in the great majority of cases.

33. Palliative processes, such as the oral administration of reconstituents and of certain antiseptics, evacuating catheterism, vesical irrigation, supra-pubic drainage, accomplish much good toward comfort and prolongation of life among those sufferers who are not in a physical condition to withstand even the immediate effects of any radical operation by reason of serious implication of the upper urinary organs. Too commonly do patients fail to seek advice until a radical operation is out of the question, and too commonly also are the major operations performed in these very cases where fire and steel both fail or kill and where general or local palliation is the only hope of prolonging life. Resort to the palliative measures just mentioned, for patients whose bad general condition contra-indicates radical operations, is seldom disappointing, and good lives are thus often prolonged, in comparative comfort, for several years.

34. Of reconstituent medication and alimentation, nothing more is needed than the mere mention of their use throughout the management of sufferers from impeded urination.

35. Of the use of those antiseptics, taken by mouth, intended to act upon the upper urinary organs and bladder through the urine, a few words of caution will suffice. They should not be given in large doses and for too long a time since their abuse is certain to neutralise the good effects of the required generous alimentation by seriously disturbing digestion.

36. Evacuating catheterism, every five or six hours, so imperatively demanded by the irritable bladder, is fraught with great dangers unless the patient be thoroughly trained, not only in the performance of that delicate operation—never to be done with metallic instruments—but in the scrupulous care of his catheters, of their lubricant, and of his hands, foreskin and glans penis.

37. Vesical irrigation should be effected by the medical attendant or by a competent nurse, and not by the patient, once or twice daily according to the condition of the urine, and once every second day even when the urine contains but a trace of pus.

38. Supra-pubic drainage is necessary when catheterism becomes difficult or impossible. This drainage has been accomplished by simply puncturing the bladder and establishing a fistula, or by a systematic epicystotomy as the late Hunter McGuire has done so successfully in many cases. Men in feeble health who at no time were in condition for a radical operation, have survived these processes for years with but little inconvenience.

39. Radical operations will be examined and described under the heads of internal and external prostatotomy and prostatectomy, and of enucleation of the prostate.

XIV

THE PROSTATE; SOME OF ITS AFFECTIONS.

1. The annotations on affections of the prostate need to be premised by such anatomic considerations as are essential to the correct appreciation of their nature and to the choice of means of relief or of cure.

2. The vesical prostatic body, unknown anciently, was not brought to light until about the middle of the sixteenth century, and to the eminent Venitian anatomist and surgeon Nicolas Massa is credited its discovery which has so greatly advanced the therapy of the urinary organs.

3. This musculo-glandular organ, in form like a chestnut with an antero-posterior diameter of four centimeters, a breadth near its base of four and five-tenths centimeters, a thickness of two and three-tenths centimeters, and a weight of nineteen grammes,* springs from the antero-inferior part of the bladder and takes a downward and forward direction; its base embracing the vesico-urethral orifice and the anterior extremities of the seminal vesicles together with the ends of the spermatic canals, and its apex being lost in the

* Among the specimens of structurally sound prostates dissected by the writer, there were many varieties in form, dimensions, and weight; such as the short and flat of two and five-tenths centimeters antero-posteriorly, one and three-tenths centimeters vertically, and five centimeters transversely; the nearby globular three and three-tenths centimeters in mean diameter; the long and slender; the under-sized of regular form; and those in excess of size and weight but otherwise normal.

membranous region of the urethra. Its antero-superior convex surface, distant from the pubic arch about two centimeters, is covered by a closely adherent layer of muscle tissue derived from the anterior wall of the bladder. Upon and among these superficial muscular bands are many veins which end in the plexus of Santorini whose efferent veins pass along the sides of the prostate where the muscular layer is much thicker and gives attachment to the pelvic fascia and to the levator ani muscle. Its postero-inferior nearly flat surface, resting upon the lower end of the rectum, is invested with a prolongation of the thin layer of muscle tissue covering the seminal vesicles. This muscular layer is attached to the prostate by moderately dense connective tissue, and to the rectum by very loose connective tissue. Thus the prostate is securely encapsulated by layers of connective and muscular tissues. Its two lobes are united, from base to apex, by an almost rudimentary superior isthmus and by an inferior isthmus, and this union forms the prostatic region of the urethral canal which is lined by a closely adherent mucous membrane. The posterior third of the lower isthmus, rich in glandular element, and styled by Everard Home the third lobe, and by Auguste Mercier the supra-montanal region, is much thicker than the anterior two-thirds of that isthmus.

4. This prostatic muscle, consisting of from two-thirds to three-fourths of its bulk of smooth tissue a part of which, together with a minimum of connective tissue, serves also as a framework for its vessels and nerves and for its aggregations of compound racemose glands; the acini of the glands containing microscopic albuminoid

sympexia which make their appearance during adolescence. These acini, in adults, are about the one-twelfth of a millimeter in mean diameter. Some of them are globular and others oval or oblong. In disease they are often visible to the naked eye. The tubes of the different bunches of acini unite to form larger tubes and these coalescing make up the terminal excretory ducts which open on the floor and sides of the prostatic sinus. In each lobe, the central mass of mucous glands is enveloped by layers of muscle tissue thick superiorly, very thick on the outer side, thin inferiorly, and very thin along the lateral wall of the urethro-prostatic sinus. This central mass of glands with its network of connective and muscular tissues is enucleable with difficulty in diseased prostates of small or even of moderate size, but with comparative ease in cases of great enlargement.*

5. The prostate is both a genital and a urinary organ: genital, because its mucous secretion contributes largely to the dilution of the semen and because, as a muscle, it helps much the ejaculation of the semen; urinary, because it aids in expelling the urine, being an integral part of the urethra. As a genital organ, it is practically rudimentary until the period of adolescence and does not attain its full size until about the age of twenty-five. It increases slightly in bulk after the age of fifty.

6. The prostate is subject to divers more or less grave affections, the chief of which are inflammatory action, cystic formation, calcareous concretions, tuberculosis,

* The statements herein made relative to the gross, minute, and morbid anatomy of this organ are based upon the careful examination and dissection of one thousand normal and diseased prostates.

new-growths, and enlargement, which for brevity has been styled prostatauxe.

7. The inflammatory affections of this organ* are super-acute, acute, sub-acute, and chronic. The inflammation may begin and end in the glandular part, in which case it is styled parenchymatous prostatitis; it may involve the interstitial connective and muscular framework and so take the name of diffuse prostatitis or may occur in the peripheral connective tissue and be designated periprostatitis.

8. Prostatitis may be the outcome of urethritis; of the contact of some irritant with the mucous membrane of the prostatic urethral region such as oft repeated strongly astringent injections for the treatment of virulent urethritis; of external injury; of violent catheterism, especially when performed with infected instruments; or of exposure to the elements. The super-acute and acute types are of rare occurrence and are generally caused by the extension of super-acute or acute urethritis into the ducts and follicles whence the inflammation diffuses itself into the interstitial substance and may even extend into the peripheral connective tissue. This is sometimes excited by the so-called abortive treatment of virulent urethritis. The sub-acute type at first affects the parenchyma only, but later invades the interstitial substance and may gradually pass into the chronic type. These several types of the inflammatory process are apt to leave the prostate in a damaged condition such as follows the destruction of much of the glandular

* The substance of the following notes is taken from the seventh lecture in "Diseases of the Urinary Apparatus, Phlegmasic Affections."

substance. Still there are many cases which end in resolution without apparent injury to any part of the organ.

9. The prominent symptoms of the acute types of prostatitis are sensations of fullness and weight in the rectum and perinæum, frequent and difficult urination, and rectal tenesmus. In two or three days these painful sensations are all greatly intensified. The rectal tenesmus is much increased in severity, there is distressing strangury, and then complete retention of urine. When the inflammation is consecutive to urethritis, the urethral discharge suddenly ceases, to reappear later. Trachœlocystitis is almost always associated with prostatitis, and two other unwelcome guests, orchitis and gonecystitis, sometimes intrude themselves to further distress the sufferer.

10. The diagnosis of prostatitis is effected through analysis of the symptoms and through rectal digital exploration which reveals heat, swelling, tension, hardness, and tenderness in the prostatic region.

11. Acute prostatitis ordinarily resolves in the course of three or four weeks, but in some cases suppuration occurs. The super-acute type almost always suppurates. The sub-acute type is slow in resolving, and sometimes ends in an abscess or in multiple purulent foci of very gradual development.

12. In the super-acute and acute types the advent of suppuration may be predicted where the occurrence of rigors and febrile reaction is followed by throbbing pains in the rectum and perinæum. The pus may find an outlet in the bladder or in the urethra, or may point forward toward the perinæum or backward toward the peritoneal cavity. The relations of the prostate to the

bladder render possible the discharge, in this viscus, of an abscess pointing superiorly and posteriorly. The directions most commonly taken by the pus are toward the urethra or the rectum. When the abscess pierces the floor of the urethra by multiple small orifices and freely discharges its contents, no serious harm ensues, but when there happens to be a large opening, the cavity of the abscess is at once filled with foul urine which very seriously complicates the local condition, the outcome being extensive tissue necrosis and general infection. When the abscess points toward the rectum, digital exploration reveals fluctuation, for, the prostate, hard and tender to the touch during the periods of increase and stasis of the inflammatory process, is now soft and but little sensitive; one or both lobes being in a suppurative state.

13. In periprostatitis, which is too frequently caused by violent catheterism, the abscess often points forward toward the perinæum. It very rarely points backward to endanger the peritonæum. This danger is fully appreciated when it is remembered that, normally, when the bladder is in a state of vacuity, the recto-vesical fold of the peritonæum descends to about thirteen millimeters of the base of the prostate, and that in some cases the peritonæum reaches or even overlaps the prostatic base. Thus may be interpreted the occasional occurrence of peritonitis as a sequence of acute prostatitis.

14. In the treatment of the acute types of prostatitis, the chief indication is to hasten resolution by a prompt antiphlogistic local treatment applied, however, only during the stages of increase and stasis of the inflammatory process, for, when there are already clear mani-

festations of softening and suppuration, this antiphlogistic treatment is worse than useless and may be productive of much harm.

15. At the beginning of the treatment of acute prostatitis the first inquiry relates to the condition of the bladder. The event of urinary retention demands that no time be lost in giving artificial relief to the distended viscus, for, unless it be emptied and kept empty or nearly so, any mode of treatment designed to favor resolution of the prostatic inflammation must inevitably fail, since the distended bladder impedes the neighboring venous circulation. But it will be remembered that catheterism for the relief of retention of urine caused by the swollen acutely inflamed prostate is often very difficult and requires the utmost caution and gentleness. In such cases the use of metallic catheters is more than likely to do serious damage to the affected parts and therefore is surely unjustifiable. The safest instruments used for the relief of the gorged bladder in acute prostatitis are the soft curved web-catheters, of no greater diameter than six millimeters, which are employed every three or four hours for a week, and afterward every five or six hours until resolution is complete.

16. The bladder relieved, the rectum is thoroughly cleansed. Then begins the local antiphlogistic treatment by application of leeches to the rectal mucous membrane underlying the inflamed prostate. This may be accomplished through the aid of the leech-tube devised by James H. Hughes, of Dublin. The subjoined is Dr. Hughes' own description of the tube and of its mode of employment. The instrument, he says, "consists of a curved gum-elastic or gutta-percha tube,

of about six inches in length, open at one extremity, closed at the other, the latter being rounded off and inverted or bell-shaped, and perforated with two or more conical holes capable of enabling the leeches to do their duty but not to escape through. The lesser curve of the tube is grooved or concave externally. The following is the mode in which the instrument should be used: The patient having been placed in the kneeling posture, the surgeon should pass the forefinger of his left hand, previously well oiled, into the rectum with a gentle rotary motion, until it has reached the inflamed prostate; he then should take with his right hand the leech-tube, previously oiled and furnished with from one to four leeches, as the case might be, and pass it along the curved dorsal aspect of the left forefinger to the exact spot where the leeches ought to be applied, the left forefinger acting as a director to the leech-tube, and forming with it, as it were, one instrument, the concave surface of the tube traversing and adapting itself to the convex surface of the finger. By this simple contrivance leeches can be brought and kept in contact with the rectal surface of the prostate without danger of their escaping from the instrument into the intestine, on the one hand, or of the tube becoming blocked with feculent matter on the other . . ."

17. Leech-tubes have been made of glass, slightly curved near the rectal extremity which is somewhat flattened and provided with two apertures not large enough to allow the leeches to escape in case of displacement of the tube.

18. This region of the rectum can, however, be leeched through an ordinary single bladed speculum, without

danger of escape of the leeches, provided the rectum be plugged with a sponge placed above the point to be leeched.

19. There may be circumstances forbidding the application of leeches to the rectal mucous membrane. In such cases, ten or twelve leeches may be applied to the perineal and anal regions; the effect of either mode of leeching being the disgorgement of the præ-prostatic plexus of veins and the relief of the blood stasis in the capillary vessels of the prostate.

20. When a sufficient amount of blood has escaped from the leech-bites, the rectum is packed with ice to be renewed every half hour or as fast as it melts; means, such as the introduction of a tube, being provided for escape of the water if it does not flow freely during the insertion of new ice suppositories. This mode of refrigeration is continued two, three, or four days, according to the necessities of the case. The relief afforded by this treatment is such that the patient slumbers refreshingly during the short intervals of renewal of the ice. At night, however, the ice suppositories are inserted but once every two hours. When it is not judged wise to effect refrigeration by way of the rectum, dry cold may be applied to the perinæum by the use of the India-rubber ice-bag.

21. Mild catharsis is effected by four gramme doses of sodium sulphate dissolved in ninety grammes of hot water every five or six hours. And diaphoresis is secured by the judicious administration of non-depressant agents. To insure diuresis, three grammes of sodium bi-carbonate in one hundred grammes of water may be given thrice daily for three or four days only. This al-

kali is used in this case on account of its double action of diluent and antiphlogistic. In cases of great suffering, a suitable hypnotic is of course indicated. The diet is restricted to broths and bread and milk.

22. Resolution, beginning within a week from the onset of the inflammation, may be promoted by hot enemata, fomentations to the hypogastric and perineal regions, and a hot hip bath of five minutes' duration every night. Constitutional medication too is helpful in hastening the process of resolution. To that end twenty centigrammes of ammonium chloride may be given every six hours, and mild saline aperients administered every morning. Under favorable circumstances, in the course of two or three weeks the prostate nearly regains its normal condition. Reconstituents and a generous diet are then indicated.

23. But when resolution fails and suppuration occurs, the sooner the pus is given a free outlet the better. Whenever the abscess discharges its contents into the urethra, the greatest care is taken to prevent the urine from entering the purulent cavity; the patient being forbidden to urinate except through a catheter which is introduced into the bladder every three or four hours at first in order to allow a sufficient time for granulation of the abscess walls. It happens sometimes that the pus points toward the rectum. In that case a speculum is introduced and an adequate incision is made, through the rectal wall, into the abscess whose cavity is well disinfected and loosely packed with antiseptic gauze. In the case of a small, purulent focus, no packing is needed and the parts are left to granulate. When, as in periprostatitis, the pus points toward the perinæum, a

central incision answers the purpose of its complete exit; but if the indications of suppuration are entirely by rectal exploration, a crescentic perineal incision, followed by careful dissection between the urethra and rectum is required to safely reach the abscess after whose evacuation and cleansing with hydrogen dioxide the wound is suitably dressed. As a general rule the parts heal in four or five weeks.

24. Prostatitis resulting from exposure to the elements is not uncommon among elderly men whose urination may or may not have been impeded before such exposure. Many cases have been observed in which the inflammatory process had its starting point in the urethral mucous membrane of the prostatic region and vesical orifice together with a superficial layer of prostatic parenchyma, causing an œdematous swelling that has been likened to œdema of the glottis from the suddenness of its invasion and the rapidity of swelling of the parts, for in two or three hours after the exposure there is difficult and frequent urination, and within six or eight hours, complete retention of urine. Artificial relief of the bladder affords only temporary relief, for resolution is generally tardy; the prostate remaining swollen and the urethro-vesical obstacle becoming permanent.

25. The same sort of inflammation is common in young and middle-aged men and is due to exposure to the elements during the decline of acute urethritis especially after a debauch in wine. This condition has been miscalled acute inflammatory stricture. In such cases the bladder, suddenly distending, causes so much suffering that the patient is likely to apply for relief on

the first day of the occurrence of urinary retention.* Formerly sufferers from this supposed "acute inflammatory stricture" were subjected to vigorous antiphlogistic treatment without due regard to the gorged bladder, but later the first care was to empty the bladder by the prompt use of a gum catheter, and then to resort to such local and general remedies as are needed, as the insertion of rectal ice suppositories for a few hours, and then the administration of a saline cathartic. Sometimes a single catheterism suffices, but it is ordinarily advisable to repeat the catheterism every six hours and to enjoin two or three days of recumbency and the free use of diluent beverages. Deliquescence, or at least very rapid resolution is generally effected by this treatment.

26. Chronic prostatitis—variously styled prostatorrhœa, catarrhal, mucous, follicular, and canalicular prostatitis—is of much more frequent occurrence than the acute types and begins in the mucous membrane of the prostatic sinus; reaching finally the utriculus, the prostatic ducts, crypts, and interstitial tissues. It is ordinarily one of the phases of chronic urethritis which may be the outcome of acute urethritis, or which may be excited by masturbation, by venereal excesses, by hyperlithuria, by the lodgment of urinary calculi in the prostatic sinus, by chronic cystitis, by a urethral stricture, by unduly frequent catheterism, by the extension of inflammation from the seminal vesicles, by the irritation caused by hæmorrhoids or the prolonged retention of catheters in the bladder, or it may be a sequel of acute prostatitis.

*See "Retention of Urine During Urethritis," notes 1 to 9.

27. The following abstract of a paper on prostatitis appeared in a recent number of *The Journal of the American Medical Association*, with the title:

Prostatitis Viewed from New Standpoint.—Posner and Rapoport argue to the effect that the secretion of the prostate has many points in common with milk and colostrum. The granulations in the prostatic fluid consists of lecithin, which is secreted by the epithelium the same as the milk fat in the breast. Whenever, for any reason, the secretion fails to find a free outlet leucocytes migrate into the gland and the leucocytes devour the lecithin granules by phagocytosis. Certain cases of chronic inflammation of the prostate are merely this combination of circumstances; the infectious element is absent. The disappearance of the lecithin granulations from the fluid is merely the result of stagnation of the secretion with consequent inroad of leucocytes and their incorporation of the lecithin. If the mechanical obstacle to the escape of the secretions can be removed, the secretions find an outlet, the leucocytes cease to flock into the gland and the inflammation subsides. This class of cases is the one benefited by massage, hydrotherapy and electricity. In the presence of chronic prostatitis, therefore, it is of the utmost moment to determine whether the inflammation is of infectious origin or is the result of mere obstruction to the outflow of the secretion.

28. The main symptoms of chronic prostatitis are: sensations of weight in the perinæum and rectum; perineal tenderness felt during the sitting posture; dull pains in the perineal and anal regions increased by active exercise and sexual contact; pains in the lumbo-sacral regions and in the lower extremities; occasional painful involuntary seminal emissions; costiveness; frequent and painful urination particularly at the close of the act; a slight muco-purulent yellowish urethral discharge; and, during defecation, a free urethral discharge of milky prostatic fluid rendered slightly viscous by the admixture of the secretion of the bulbo-urethral glands. The characteristic odor of the secretion of the

urethral crypts is imparted to the escaping prostatic fluid as well as to the semen, which, by themselves, are odorless. To the escape of mucus from the prostate and urethra the name prostatorrhœa owes its origin, and from this symptom arose the erroneous popular belief that the glairy milky fluid in question is semen. This frequent discharge of prostatic mucus is a source of great anxiety to some patients, who imagine themselves affected with "seminal incontinence" and impotency, and soon become the easy victims of designing charlatans.

29. In a large proportion of cases of chronic prostatitis the mucous membrane of the sinus is in a granular state, as seen through the urethroscope. In some instances small retention cysts due to the occlusion of ducts, or degeneration cysts, or multiple abscesses, are slowly developed in the substance of the prostate and are detectable by rectal digital exploration and by subsequent puncture with a small trocar. In very rare cases the greater part of one lobe is destroyed during the suppurative process.

30. The granular condition of the sinus referred to in the preceding note has been verified by dissection of the organ in patients dying from intercurrent disease; the granular mucous membrane being very red from a highly congested state extending to the vesico-urethral orifice. In some cases the prostate was soft and spongy, larger than normal, and contained degeneration cysts, or small abscesses, while in others the organ was hard, shriveled; sometimes containing many small retention cysts, and the utriculus was occasionally distended with pus.

31. When the prostatic crypts are involved in the inflammatory process their microscopic sympexia are set free by the exudate and are then metamorphosed into calculi which, by the accretion of concentric layers of calcium phosphate, attain very considerable dimensions. In one case a thousand such calculi, each of about half a millimeter in mean diameter—except three, one of which weighed three grammes fifty centigrammes and the other two together weighed twenty centigrammes—were removed, through a perineal incision, from the prostate of a patient twenty-six years of age. In another case, eighteen prostatic calculi were similarly extracted from a man fifty-four years old. These eighteen calculi averaged seven millimeters in size; the largest measuring ten by fourteen millimeters, the smallest three millimeters; the whole weighing nine grammes. Both patients were cured by the operation. The second patient was seen ten years after the operation and was well in health.

32. In about five per cent. of the prostates dissected by the writer during a period of thirty years, several small calcareous concretions were found occluding the mouths of prostatic ducts or lying free in the sinus, and in a much greater percentage of these prostates, particularly those of elderly men, the calcareous transformation was verified by the inordinately gritty state of the organ's substance. It is when they are disturbed by the exudate, which dilates the crypts, that the sympexia becomes practically foreign bodies which, if not speedily expelled, serve as nuclei around which are formed concentric layers of calcium phosphate. Occurring in early or in middle life they generally increase in

size very rapidly, whilst in advanced life they do not generally attain dimensions which render them visible to the naked eye, but their presence in great abundance is known when the prostate is incised and its gritty condition manifested. This gritty condition of the enlarged prostate of elderly men and the ectasia of the crypts—first noticed by Dr. Mercier who, notwithstanding his discovery, denied inflammatory action as causative of prostatic enlargement—seem to establish the fact that augmentation of volume of this organ in old men is ordinarily the outcome of chronic follicular prostatitis; increase of the muscular element occurring very slowly.

33. In chronic prostatitis due to urethral stricture, not only are the ducts dilated by the refluent urine but the sinus also sometimes undergoes expansion. Three such cases of extreme ectasia were observed. In one of these cases the sinus had a capacity of thirty cubic centimeters; the substance of the prostate being soft and spongy. In another case the capacity of the dilated sinus was of sixty cubic centimeters. The walls of the sac thus formed, consisting of the substance of the prostate, were of irregular thickness, from three to five millimeters. Long continued cystitis together with frequent violent efforts to urinate had reduced the capacity of the bladder to a minimum and had caused its thickening to more than one centimeter. On its right side, close to the ureter, was a diverticulum whose capacity was seventy cubic centimeters. There was also a well marked urethro-vesical bar. The kidneys showed signs of inflammation and fatty degeneration and weighed two hundred and sixty grammes. In the third, the

ectasia was quite as great as in the second case, and the prostatic sac contained a calculus by which it was nearly filled.

34. The diagnosis of chronic prostatitis must be based upon close analysis of its symptoms, and upon the history of the affection and of the affected. The symptoms can be rightly interpreted only in connection with the urinary examination and the physical exploration.

35. The urine of sufferers from chronic prostatitis is generally more or less cloudy owing to the presence of pus and epithelium from the sinus prostaticus. The many shreds and scrolls so commonly seen in this urine are shown, on microscopic inspection, to consist of pus, epithelial cells, and some entangled red blood corpuscles. Among these shreds and scrolls are seen certain long cylindric bodies which appear to be casts of the smaller prostatic ducts. Great quantities of octahedra of calcium oxalate are frequently found in the urine of these patients, while at times lozenges of uric acid, and at other times the urates greatly abound. Besides these urinary salts, many minute sympexia, cast away from the prostatic crypts, are often seen in this urine, particularly in the case of elderly men.

36. A convenient way of obtaining pus direct from the prostatic sinus, for microscopic examination, is to introduce, as far as the end of the urethral bulb, a hollow, soft, acorn tipped bougie, at the base of whose acorn of eight millimeters diameter are three or four small perforations, and to syringe in about a hundred grammes of warm water for the purpose of washing away by the retrograde current any pus that may have accu-

mulated in the spongy urethra. This accomplished, the bougie is carried onward into the prostatic sinus and then slowly withdrawn. The pus coating the base of the acorn is then placed upon a glass slide and subjected to microscopic examination to reveal some of the objects specified in the preceding note and so help to establish the diagnosis.

37. By digital rectal exploration it is ascertained if the prostate be tender or insensible to the touch, hard or soft, decreased or increased in size, smooth or nodular, if nodular whether the nodules be firm from organized plasma, doughy from purulent accumulation, tense from cystic formation, or of stony hardness from the presence of calculi.

38. The urethra is then explored for the purpose of excluding or of establishing the existence of stricture, and the examination is carried farther to the urethro-vesical orifice and the bladder; in the one case to include or exclude trachœlo-cystitis, in the other to search for stone; the granular condition of the sinus being ascertainable with the aid of the urethroscope. These explorations are needed although certain symptoms point, with reasonable clearness, to the existence of the affection; such for instance as the sharp pain felt at the urethro-vesical orifice during urination as it is the moment of entrance into the bladder of a catheter, either of which indicates the coexistence of trachœlo-cystitis; the persistent vesical pains, which simulate a symptom of stone, warranting exploration of the bladder with a rectangular staff to clear all doubts in this respect. When, however, the pain caused by any exploration of these parts is slight and confined to the prostatic region,

the case may be regarded as uncomplicated chronic prostatitis.

39. The treatment of chronic prostatitis is varied in accordance with its different phases, complications, and consequences. Uncomplicated chronic prostatitis attended with a flow of from a few drops to three grammes of prostatic fluid during defecation, so common among continent men, and still more so among those addicted to masturbation, requires moral as well as local and constitutional treatment.

40. The moral treatment is one of the most difficult of the self imposed tasks of the physician, who must employ much circumspection before he can pass judgment upon the needs of particular cases. In examining any sufferer he may exercise the greatest firmness, tempered, however, with patience, forbearance, and kindness. Thus he enlists the patient's confidence and endeavors to convince him that his ailment is curable, that he is not suffering from "seminal incontinence," that he is not impotent, and that he can not be cured unless he give up the bad habits he may have acquired, and occupy his mind with the consideration of subjects other than his complaint. When the patient is responsive to the normal treatment, more than half the cure may be regarded as accomplished.

41. The local treatment of uncomplicated chronic prostatitis consists in irrigating the sinus once daily with the object of washing away the pus and mucus which have accumulated in the sinus and larger prostatic ducts. The fluid for irrigation is a two per cent. watery solution of boric acid; not less than one hundred grammes of the solution being used for each irrigation. These irriga-

tions are ordinarily employed as preparatory to such more active measures as may be required in any case, but in certain mild cases are by themselves curative. Irrigation of the prostatic sinus is effected through a gum catheter of about seven millimeters diameter introduced into the membranous region of the urethra; the injected fluid distending the sinus as it passes through and dislodges and carries into the bladder the muco-purulent contents of the prostatic ducts and sinus. The hundred grammes of solution having been exhausted, the catheter is pushed into the bladder whose contents are allowed to escape into a glass vessel to be examined for floculi of pus and epithelium and so make sure that the cleansing process is accomplished; otherwise the irrigation is repeated.

42. Frequent irrigations are very effective in the chronic prostato-cystitis of elderly men. In many cases the prostatic sinus is filled with a plug of tenacious slime which, for hours, is a source of much irritation and of frequent prostatic spasms until the plug is forced out by a stream of urine. The daily use of irrigations with the boric acid solution almost invariably has the effect of breaking up this tenacious slime or of preventing its accumulation. In case of the coexistence of granular urethritis of the spongy portion, it is wise to irrigate the whole canal; and when these simple irrigations are insufficient, the use of steel sounds of increasing size has the double effect of dilating the canal and, by the compression thus exerted upon its parieties, causing the disappearance of the granulations. The sounds need not be passed oftener than twice each week. Besides this process of dilatation, the prostatic urethra, after being duly

cleansed, may be irrigated, every third day, with a silver-nitrate solution five centigrammes to thirty grammes of sterile distilled water; its strength being increased at subsequent sittings to ten, fifteen, or even twenty centigrammes to the thirty grammes of water. Ninety or a hundred grammes of urine left in the bladder will insure the quick decomposition of the silver salt designed to act solely on the prostate. The immediate effects of the injection are severe pains in the prostatic region and frequent and irrepressible urination lasting one, two, or even three hours with slight accompanying hæmorrhage. Afterward, the muco-purulent discharge is increased, but soon lessens and ceases in two or three days. It often happens that after the effects of the first injection there are scarcely any signs of prostatitis, but as a general rule several injections are needed to effect a cure.

43. Careless catheterism, sexual excitation, debauch in wine, or error in diet, among sufferers from chronic prostatitis, is known to provoke a profuse creamy urethral discharge which simulates acute virulent urethritis and is attended with inordinate frequency in urination and a train of symptoms apt to mislead the inexperienced. In cases of this sort, heroic treatment would be more than likely to greatly worsen the ailment and lead to serious complications, whilst speedy resolution of the sudden inflammation would be ensured by mild measures such as the free use of diluent drinks and two or three days' rest after which the local treatment could be resumed with safety.

44. In the treatment of complicated cases of chronic prostatitis, success is attainable only when due attention

is given at the same time to the complications. If chronic cystitis exists, it demands special treatment; if a urethral stricture is detected, its dilatation, divulsion, or incision is required; if painful hæmorrhoids or anal fissures should be the complication or cause, they are appropriately treated. When prostatic calculi have already formed, they are to be removed without delay. Small cysts or purulent foci may be tapped by way of the rectum, with a slender trocar, and duly disinfected.

45. For those cases attended with constant dull pain in the perineal region and tenderness of the prostate, it is proper to resort to counter-irritants; painting the perinæum with strong tincture of iodine, first on one side of the raphé, then on the opposite side, every two or three days, often answers the purpose; otherwise, vesicating collodion may be similarly applied for a few weeks. In either case avoiding the scrotum and anus, covering the vesicated part with a layer of absorbent cotton. Suppositories of opium and belladonna may be used occasionally to relieve pain.

46. Constitutional medication is rendered necessary by the ordinarily impaired health of sufferers from chronic prostatitis, and this medication is varied according to circumstances. The use of bitter tonics in conjunction with a suitable dietary is likely to sharpen the appetite and promote digestion. Active treatment for hyperlithuria may be required. Iron and quinine are given as reconstituents, and laxatives are ordered to prevent fecal accumulation. These prescriptions close the catalogue of needful internal medicaments. Frequent general bathing followed by brisk friction and proper exercise, comprise the hygienic measures.

XV

THE PROSTATE; THE NATURE AND EFFECTS OF ITS ENLARGEMENT

1. Close and scrupulous as may be an inquiry into the nature and effects of enlargement of the prostate; precise as may be the interpretation of its symptoms; and essential as is a right selection of therapeutic means needed in the management of a particular morbid condition discovered; it is of much scientific interest, and also of no little practical importance that this inquiry be premised by the most careful consideration of the evolution of the present knowledge of the different causes and kinds of increase in bulk of this organ.

2. The great suffering entailed by obstructed urination though graphically recorded by many observers in remote times was not rightly interpreted until the dissection of human bodies became frequent and until Riolan, early in the seventeenth century, affirmed that the neck of the bladder could be stopped up by tumefaction of the prostate. This declaration, however, was scarcely heeded, and little was done to acquire a more exact insight of the ailment until the beginning of the nineteenth century when began the first real advances toward a practical knowledge of the nature, effects, and treatment of prostatic enlargement. Honorably associated with these advances are the names of Everard

Home, Benjamin Brodie, Jean Civiale, and Auguste Mercier. These eminent men were the true pioneers in this field of investigation, and the present generation is reaping the benefits of their arduous labors.

3. The writers whose names appear in the preceding note regarded prostatic tumefaction as a disease of old age, and styled it chronic senile enlargement of the prostate after stating the general and special indications of its existence, and calling attention to its slow development. The language used by some of them in expressing these views is well worth quoting. Brodie's words were that "when the hair becomes gray and scanty, when specks of earthy matter begin to be deposited in the tunics of the arteries, and when a white zone is formed at the margin of the cornea—at this period the prostate . . . usually, I may say invariably, becomes increased in size. This change in the condition of the prostate takes place slowly, and at first imperceptibly, and the term chronic enlargement is not improperly employed to distinguish it from the inflammatory attacks to which the prostate is liable in earlier life." Mercier entertained practically the same ideas which he expressed substantially as follows: "The prostate, like all the other organs, I might even say more than most of the other organs, undergoes with age changes which it would be useful and curious to follow from early life to extreme old age. . . . As soon as a man has passed fifty, one may be almost certain that his prostate has increased in volume." Similar views were expressed by other writers among whom were Adams and Hodgson; the first saying that "in advanced age, when all or most other structures in the body begin

to show evidences of want of nutrition and become atrophied, or waste by interstitial absorption, the prostate . . . very frequently undergoes a remarkable increase in size. This change . . . is so common after the age of fifty, that an enlarged prostate may be almost regarded as one of the necessary contingencies of old age."

4. These views, so well expressed by men of such great ability, have since been modified, in several particulars, through further experience and observation enlightened by modern patho-anatomy. It is now acknowledged that "chronic senile enlargement" of the prostate is by far the most common affection of this organ, but that the disease necessarily occurs in every man after the age of fifty is clearly not the case, and there is an abundance of evidence from daily observations and from the testimony of some of the most competent authorities. It may therefore be safely averred that not more than one out of three men of upward of fifty years old is affected with enlargement of the prostate.

5. The term enlargement is here used instead of *hypertrophy* with its strict meaning of over nourishment and its arbitrary signification of increase in size of particular organs as distinguished from hyperplasia which occurs in the prostate as well as in other parts of the body. Although increase in size of the prostatic acini occurs, hypertrophy can not, with accuracy, be employed to designate enlargement of the acini or of the organ because the morbid states which cause increase of its volume are many, and in none of them is the organ over nourished. The contrary seems to be the case for,

the venous-blood stasis which exists in diseased conditions of the prostate surely points to under rather than to over nourishment. Surely, increase in volume of this organ from malignant disease, tuberculosis, etc., can not be truly designated as hypertrophy.

6. Physical exploration during life and dissection after death have long since demonstrated that prostatic enlargement is neither a single morbid entity nor a single morphic entity. The chief morbid states that cause increase in bulk of the prostate are described in the following notes.

7. Acute inflammatory action gives rise to a prostatic enlargement which disappears when resolution is complete, or which persists longer, as in the case of diffuse suppuration or of abscess formation. In some cases, acute prostatitis ends in the gradual shrivelling of the organ instead of its enlargement, and this shrivelled state may cause obstruction to urination. The variety of acute inflammation with œdema of the mucous membrane of the sinus extending to and closing the urethro-vesical orifice and involving the prostatic ducts, causes a general swelling which, ordinarily is only transitory. Sometimes, however, this prostatic swelling persists several weeks or even several months after the subsidence of the acute inflammation. In sub-acute prostatitis, the persistence of swelling is even more common than the afore-named variety of the acute form.

8. Chronic parenchymatous prostatitis is a cause of transitory, as well as of permanent, enlargement of the organ. Transitory when, after a suitable course of treatment, the swelling vanishes, or when, rapidly increasing calcified sympexia are artificially removed, the

swollen prostate soon decreases in volume or even shrivels. Permanent when, dilatation of the acini occurs, together with some increase of the muscle tissue; the calcified sympexia remaining almost microscopic in size. Such prostates generally become very large, are comparatively soft, and occur with much greater frequency than the other kinds. Dilatation of the sinus sometimes greatly increases the size of the organ.*

9. Retention cysts, due to dilatation of acini from obliteration of excretory ducts, sometimes attain such dimensions as to increase very materially the bulk of the prostate or even to impede urination. A prostate of normal size, dissected by the writer, exhibited a superficial retention cyst one centimeter in diameter at the right of and nearly closing the urethro-vesical orifice. Degeneration cysts are also sometimes found in this organ, large enough to cause urinary retention. Hydatid cysts are of extremely rare occurrence in the substance of the prostate; they are occasionally found in its immediate neighborhood and. by mechanical pressure interfere with urination.

10. Tuberculosis attacking either the bladder or the urethra eventually infect the prostate, whose volume is thereby sufficiently increased to affect urination. This very rare affection of the prostate has always been secondary, so far as observed by the writer.

11. True adenomata, those new growths of glandular substance with imperfectly elaborated sterile structure, are comparatively rare and are transformable into carcinomata and sometimes into adeno-sarcomata which soon cause great increase in the size of the prostate and serious impediment to the urinary flow.

* See note 33 Chronic Prostatitis page 258.

12. Of primary carcinomata of the prostate, the writer has met with only three cases which had caused obstruction to the passage of the urine. In two of these cases, the diagnosis was made some time before the death of the patients, and the third was discovered on dissection of the parts. He has failed to find any additional examples of primary prostatic cancer among the many hundreds of diseased prostates which he has examined during a period of thirty years.

13. Recent investigation has led a competent observer to conclusions the very opposite of those expressed, in note 12, anent the rarity of prostatic cancer. Dr. H. H. Young, in a paper on "The Early Diagnosis and Radical Cure of Carcinoma of the Prostate," * declared that cancer of this organ is of frequent occurrence and that he had witnessed fifty cases, in six of which he performed complete prostatectomy with excision of the antero-inferior part of the bladder cut a little in front of the ureteric orifices, and the removal at the same time of the fore-parts of the seminal vesicles and lower ends of the spermatic canals. Three of the six patients subjected to so complete prostatectomy died, and three recovered. One of the first three died soon after the operation, another two months, and the last one year later from an operation for vesical calculi, but the cancerous disease had already recurred. Of the next three cases, one was well ten months, one eight months, and one a month after the operation.

14. If malignant growths of the prostate are so frequent as believed by Dr. Young, the conclusions, stated in note 11, relating to the infrequency of adenoma

* Journal of American Medical Association, March 10, 1906.

of this organ, must be wrong and prostatic adenoma therefore a more common morbid product transformable into carcinoma or sarcoma.*

15. Fibrous tumors too are of equally rare occurrence and are transformable into sarcomata, however, primary sarcomata do sometimes occur in the prostate to cause its great enlargement. But this may arise even in early life, as exemplified by a case reported by Hodgkins in the fourteenth volume of *The Lancet*, 1843. The patient was a lad, seven years of age, who began to suffer from dysury, and then urinary retention, about three months before his death. The necropsy revealed an enormous prostatic tumor whose "length was seven inches, and whose breadth was four and a half or five inches. It weighed between three and four pounds." The rest of the description of the parts, and the history of the progress of the case, leave no doubt as to the sarcomatous nature of the tumor.

16. Diffuse increase of the prostatic fibrous framework is also very rare, and like the isolated fibrous tumors, is liable to sarcomatous metamorphosis. Although this diffuse increase of fibrous tissue may cause but little augmentation in the bulk of the organ, it obstructs urination as much as do very large prostates, owing to its hardness and to the vesico-urethral bars which it almost invariably forms.

17. Circumscribed myomata occasionally occur in the prostate as they do in other parts of the body, and often

*At St. Mary's Hospital, Rochester, Minnesota, from January 1, 1905, to August 20, 1906, were performed one hundred and twenty-three prostatectomies, of which twenty-two cases were of carcinoma, and two cases were of tuberculosis. This information was obtained through the kindness of the Pathologist of St. Mary's Hospital.

greatly obstruct urination. In some of the specimens examined, acini and ducts were found in these myomata.

18. Though the prostate is often much enlarged without producing serious effects, it is clear that its enlargement cannot be regarded reasonably as a single morphic entity. This is shown in the following statement of the main varieties of form.

19. The enlargement may be limited to one lobe of the prostate, or may involve the two lobes. Enlargement of the lobes may be unequal, one being very much larger than the other. One or both lobes may project into the bladder. One or both lobes may encroach upon and nearly close the prostatic region of the urethra and render its course irregular or even spiral. The posterior third of the lower isthmus alone may be enlarged in the form of a roundish pedunculated tumor, or of an irregular sessile mass, or of two separate sessile growths. The whole of the lower isthmus alone may be enlarged. Both lobes and the posterior third of the lower isthmus may be enlarged. The increase of both lobes may be downward and backward toward the rectum, overlapping the anterior third of the seminal vesicles. There may be only a bar at the neck of the bladder with little, if any, apparent enlargement of the prostate. There may be intra-mural isolated tumors which are not perceptible before incision of the organ, or which, being sometimes superficial, are discoverable through rectal digital exploration. Multiple tumors, from one or both lobes, may project into the urethra, with or without enlargement of the posterior third of the lower isthmus. Multiple tumors, with or without

general enlargement, sometimes spring into the bladder from the posterior third of the lower isthmus.

20. Here, then, are greatly differing morbid states which cause enlargement of the prostate with many varieties of form. Does it not seem plain, in consideration of such diversity of morbid states and freaks of form—this last demanding the careful selection of the evacuating catheter best suited to a particular form—that no exclusive method of treatment of these conditions can consistently be adopted, and that the proper management of any case must be premised by a diligent inquiry into the nature of the particular morbid state and the form and extent of the enlargement?

21. Chronic progressive enlargement, being the most frequent of the diseases of the prostate in elderly men, is entitled to the largest share of attention in these notes. Very often physicians are consulted by younger brethren in behalf of patients, under the age of forty, supposed to be suffering from chronic enlargement of the prostate, but who, in reality, are harassed by dysuria due to transitory prostatic swelling or to spasmodic contracture of the vesical neck, either being a common sequel of urethritis or of persistent hyperlithuria. This misconception of the nature of chronic prostatic enlargement still exists in the minds of some physicians notwithstanding the frequent reiteration, for many years past, that this affection does not generally occur until the sufferer has attained two score and ten years of age. The inexperienced are constantly mistaking inflammatory swelling for the slow, steady increase in bulk of this prostatic body, which so seldom begins before the age of fifty. It therefore seems justifiable to dwell upon

the oft repeated statements that chronic progressive enlargement of the prostate is a disease of elderly men; that not more than thirty-five per centum of men between the ages of fifty and seventy years are affected with this chronic enlargement; that the ailment does not ordinarily manifest itself before the age of fifty-five; that it very rarely begins after the age of seventy; and that out of the thirty-five per centum of cases, not more than one in every five or six suffers seriously from disordered urination.

22. This chronic enlargement was originally regarded as a sequel of inflammatory action, but the phlegmasic theory, rejected toward the middle of the nineteenth century, was after all correct and is well worthy of revival, for, in the present lights of science, it has a sound basis, and has already been adopted by several careful observers.

23. In a paper on prostatic enlargement published in the year 1896, the writer thus expresses his own convictions in regard to the phlegmasic theory, as follows: "A re-examination of the question with the aid of modern methods of study, has led to the belief that phlegmasic action—often excited by hyperlithuria which is so common between the ages of forty and sixty—is a potent factor in the causation of this chronic enlargement.* Post-mortem evidences point to a low grade of inflammation in the prostatic parenchyma, and microscopic inspection of the soft prostate of the elderly men shows that its structure is not identical with what is known as a new-growth, but that the increase of bulk is due to

* Any sort of urethritis is liable to affect the prostatic parenchyma and so be the cause of prostatic enlargement.

dilatation of the acini, with augmentation of the muscle tissue bands. Such increase of muscle tissue seems to be an effect of violent and frequent contractions of the bladder and prostate in their efforts to expel retained urine. Therefore, this increase of muscle tissue is secondary to the diseased state of the acini involved in the passive phlegmasia that yields an exudate sufficient to distend them and float the sympexia which are soon incrusted with concentric layers of calcium phosphate and thus become irritant bodies serving to aggravate the existing condition. Many of these calcified sympexia are discharged through dilated ducts and are found in the urine, but others remain in the acini or are impacted in ducts, and the consequence is accumulation of secretion, further dilatation of the acini, and general or local increase of the prostate. . . . Analysis of the record of every new case affords some evidence of the phlegmasic origin and slow development of chronic enlargement of the prostate. Mercier recognised the dilatation of the acini and the calcification of the sympexia, but was one of those who rejected the notion of the phlegmasic origin of chronic enlargement of the organ; and yet he believed this enlargement to be due in great part to passive congestion. This admission is surely favorable to the phlegmasic theory. Some modern writers regard chronic prostatic enlargement as adenoma, but this view is certainly not in accord with the present definition of an adenoma which is a new growth of adenoid substance with imperfectly elaborated sterile structure. Adenomata, as well as the other new-growths, are found in the prostate, but their occurrence is very rare. In the great majority of cases of chronic

enlargement of the prostate there is not the least appearance of new growth of glandular substance. The acini are not increased in number, but are greatly dilated, some of them from five to twenty times their normal size, and, ordinarily, the muscle tissue is only slightly increased. Besides, there are, in and around these prostates, unmistakable signs of secondary phlegmasic action. The peri-prostatic veins are gorged with blood, and in some cases are occluded by phleboliths. Although the surrounding tissues are indurated, the substance of the prostate is soft and spongy."

24. Chronic inflammation of the seminal vesicles and spermatic canals appears to be frequently associated with chronic inflammation and progressive enlargement of the prostate. In seventy-five per centum of the chronicly enlarged prostates of elderly men dissected by the writer, there were marks of inflammatory action between the base of the bladder and the rectum, such as induration of the ambient connective tissue, particularly that which surrounds the seminal vesicles; and these vesicles were hardened and shrivelled, and in some cases their fluid was purulent. The absence of spermatozooids and the presence of many enlarged sympexia were conspicuous in the mucus of the vesicles. The spermatic canals were abnormally hard and sometimes occluded. In a few cases there were cystlike dilatations of the vesicles due to occlusion of their excretory ducts.

25. Amongst the dissected prostates of men between the ages of fifty and fifty-five, many of the specimens exemplified the beginning of enlargement of the lower isthmus and of the lobes. In a few instances, projecting from the surface of this isthmus, were seen small foci

of dilated acini, appearing as little tumors from one to three millimeters in size. The increase of such growths is so slow that the organ does not become very bulky until the sufferer is far advanced in years. In certain cases, the muscle tissue is in excess whilst in the vast majority it is the dilatation of the acini which predominates; the gritty calcified sympexia being discernible when the prostate is incised with a sharp knife.

26. To illustrate the inflammatory origin and slow development of chronic enlargement of the prostate, the following examples are given out of many carefully studied cases.

27. A patient, fifty-five years old, who had suffered from persistent hyperlithuria for more than five years before his first symptoms of chronic prostatitis, noticed, at the age of fifty-two, a slight muco-purulent urethral flow, chiefly during defecation, together with uneasy sensations in the perinæum and rectum, but did not apply for treatment until a year thereafter, when he had begun to be annoyed by unduly frequent urination for which he consulted the writer. He was then fifty-three years of age, had no appreciable prostatic enlargement and was well able to empty his bladder. In the course of a year he was again examined, through the rectum, and the volume of the prostate seemed slightly increased, but there was no residual urine in the bladder. Six months after this, he had an attack of cystitis during which the urine was purulent and fetid, but became clear after six weeks treatment, when his physician declared him well. Nevertheless, the frequency of urination by day increased, and he was obliged to urinate

twice each night. He was then referred back to the writer, complaining of pain in the hypogastric and perineal regions and of frequent desire to urinate day and night. His mode of urination, in presence of the writer, was characteristic of urethro-vesical obstruction. At the first attempt he could pass but thirty grammes of urine; after moving about for two or three minutes, he discharged one hundred and twenty grammes, and a few minutes later, sixty grammes; in all, two hundred and ten grammes. A curved silk-web catheter was then easily introduced, and one hundred and twenty grammes of clear urine drawn off. Digital rectal exploration revealed an undue rotundity of the prostate and an increase in volume estimated to be about one-third in excess of the normal average. By the aid of Mercier's short-beaked, rectangular staff, a moderate increase of the posterior third of the inferior prostatic isthmus together with a corresponding depth of the lower vesical fundus, was detected, and this accounted for the residual urine. The hatching of the prostatic enlargement, in this case, seems to have lasted at least six years.

28. Only two more instances need be cited out of many examples of the very slow development of the disease. In the case of a man aged seventy-seven years, prostatic enlargement had existed ten years before complete retention of urine occurred and subsequent regular evacuative catheterism became necessary. In that time, the prostate had not more than doubled in size. Fourteen years had elapsed, in the other case, from the beginning of enlargement of the organ, before the use of the catheter became imperative. The patient was then eighty years of age, and, after these fourteen years, the prostate

had more than quadrupled in size before it caused any serious obstruction to urination.

29. The diseased prostate sometimes attains very much greater dimensions than in the cases mentioned in the foregoing note. Amongst the last specimens dissected by the writer, one, taken from the body of a man who was sixty-seven years old at the time of his death, measured six centimeters and a half in thickness, six centimeters from base to apex, and nine centimeters from side to side. In addition, the posterior third of the lower isthmus, four centimeters broad, projected three centimeters and one-fifth into the bladder, bulged toward the rectum, and pushed aside the spermatic canals and seminal vesicles which were shrivelled and hardened. The length of the prostatic urethra was six centimeters. The vesical wall at the lower fundus was much indurated and irregularly thickened from one and a half to two centimeters. The bladder, whose capacity did not exceed one hundred and twenty cubic centimeters contained a small phosphatic calculus. The caliber of the ureters was more than doubled and there was, on both sides, pyelo-nephritis; the kidneys being more than twice their natural size. Notwithstanding this great increase of the prostate, the introduction of instruments was exceptionally facile, and the fact was accounted for after dissection, when the two lobes were found to be equally enlarged and the prostatic urethra very little curved owing to the inordinate thickness of the superior isthmus; the whole of the inferior isthmus being also very much enlarged. In a specimen prepared many years ago, the posterior third of the lower isthmus made up about one-third of the bulk of the diseased organ

in the form of a round mass, five centimeters in mean diameter, which nearly filled the lower vesical fundus. Many other examples of extreme enlargement of this organ are on record, but only a few of them need now to be mentioned. In his work on "Diseases of the Prostate," Sir Henry Thompson figures and describes a prostate "nearly the size of a cocoanut, and weighed nine or ten ounces." The patient had "expelled his urine very frequently and with difficulty, but emptied his bladder completely." This is a valuable illustration of the fact that general enlargement of the prostate, with great protrusion of the so-called third lobe, does not always abolish urination. Ford is cited by Mercier as having published, in the year 1802, the account of a diseased prostate which weighed "nine ounces." Bartholinus is said to have seen a prostate equal in size to a man's head. This statement is regarded by Mercier as an exaggeration. Probably the largest prostate exhibited in modern times is the specimen figured by Dr. F. S. Watson, of Boston, in his essay on "The Operative Treatment of the Hypertrophied Prostate," 1888, plate XVII. The bladder having been cut away, the diseased mass was photographed. The picture measured eighteen centimeters in extreme longitudinal diameter, fourteen centimeters and seven-tenths in its largest transverse diameter, and ten centimeters and three-tenths in its smallest transverse diameter.

30. The other extreme in point of development is illustrated by a specimen taken from an elderly man whose death was due to the consequences of obstruction to urination by a very slight enlargement of the posterior third of the lower isthmus, which, however, had almost

entirely closed the vesico-urethral orifice; the rest of the prostate being not more than two-thirds the average size.

31. Of the diagnosis of prostatic enlargement, the exact statement is of much importance, not only to the practising physician but to the vital statistician. Too frequently only a condition common to enlargement of the prostate, urethral stricture, and stone in the bladder, appears in tables of diseases, without explanation, as "retention of urine, chronic cystitis," etc. . . . The writer, in endeavoring to obtain information about the relative frequency of the urinary diseases of males, examined the annual reports of many institutions for the care of disabled elderly men and found it always very difficult, and sometimes impossible, to determine the precise character of the diseases catalogued in these reports whose great value would be so much enhanced if the compilers were permitted to place, in brackets and in italics, the name of the primary disease, as for instance: Retention of urine [*from urethral stricture, or from prostatic enlargement*], as the case might be; chronic cystitis [*from urethral stricture, prostatic enlargement, or vesical stone*], etc. . . . Such additions would lighten the labors of, and be gratefully appreciated by, medical investigators and statisticians, and add much to the precision and value of their researches.

32. To ascertain the existence of prostatic enlargement is often easy, but to identify any particular kind of enlargement requires a fair knowledge and the exercise of a clear discernment of the several morbid states and of the varieties of form to which this organ is subject. Hurried, superficial examination is almost certain to lead

to an erroneous diagnosis and this to improper treatment. A case in point was that of an elderly man, affected with prostatic enlargement, whose physician had seemed to take into account only the fact of the enlargement, and therefore, suggested what he conceived would be a radical operation. The patient then consulted another physician who, after a very careful study of the case, advised against any operative interference, for the time being, other than evacuative catheterism and daily vesical irrigation; his diagnosis being sarcoma of the prostate with a secondary nodule in the hypogastric region of the abdominal wall. The prostate then increased in size so rapidly that suprapubic cystotomy for drainage became necessary, and afforded great relief to the doomed sufferer.

33. Prostatic enlargement is seldom recognised during the early stages of its development, chiefly because the sufferers very rarely seek medical advice until the disease has advanced sufficiently to impede urination. Great enlargement of this organ has often been discovered incidentally in patients the course of whose urine had never been disturbed. In like cases the enlargement is generally uniform, without "third lobe." However, it should be borne in mind that these prostates are liable to such acute swelling from exposure or from debauch on the part of the patients, as to cause retention of urine and cystitis necessitating frequent evacuative catheterism, and that this swelling often lasts many weeks or months; finally subsiding so that the sufferers are again able to urinate in a good stream and empty their bladders. Another fact, worth remembering in connection with diagnosis, is that very large prostates that had not

caused the least inconvenience and the existence of which had never been suspected, have been found in the bodies of old men dead of acute disease of some distant organ.

34. A correct diagnosis is reached through the analysis of certain symptoms peculiar to prostatic obstruction and also of course through physical exploration by way of the rectum and of the urethra.

35. When urination is very frequent and much disturbed, day and night, in an elderly man free from urethral stricture or vesical stone or tumor, the existence of multiform prostatic enlargement may be predicated. It has already been said that the hatching of chronic senile prostatic enlargement is a very slow process; several years generally elapsing before any symptom of impediment to the exit of urine is perceived. The patient then becomes conscious that there is something wrong with his urinary apparatus, on account of frequent desire to urinate and later, of difficult and sometimes painful urination. But these symptoms, being common to several other urinary affections, are likely to lead him astray as to the nature and consequently as to the management of his complaint. Frequent and difficult urination by day and by night, a sensation of fulness and weight in the perinæum and rectum, lumbago, and sciatica, are valuable symptoms only when rightly interpreted. Frequent urination points to stagnation of urine and consequent cystitis. Difficult urination is evidence of obstruction, but the obstruction may be due to a urethral stricture or to the impaction of a calculus in the urethra. However, in the case of an elderly man, free from urethral or calculous disease,

difficult and frequent urination forbodes prostatic obstruction. During the conduct of all cases of prostate disease, chemical and microscopical examinations of the urine, so helpful in diagnosis, prognosis, and therapeusis, need to be made from time to time.

36. The mode of urination indicative of prostatic obstruction is worthy of special notice. The patient, in endeavoring to relieve his more or less distended bladder, stands leaning forward with his legs spread and bracing himself with one hand against a resisting object. After some delay, the urine issues forth in a small, feeble, vertical stream which soon stops, to be followed by the dribbling of twenty or thirty drops that are succeeded by the small stream; and this sort of urination continues until, in the course of two or three minutes, from thirty to fifty grammes may thus be expelled. This process is repeated two or three times, with varied success, when the introduction of a catheter reveals the presence of from one hundred and eighty to five hundred grammes of residual urine. This kind of urination only characterises obstruction from prostatic enlargement, it does not specialise any of the varieties of form.

37. Physical examination through the rectum discloses, in a great degree, the extent of enlargement of one or of both lobes, or multiple nodules indicating the presence of large calcified sympexia, or of isolated myomata, or of cancerous growths. Hardness does not necessarily signify induration of the whole prostatic mass, for the periphery only may be hard whilst the central portion may be soft and spongy. When digital rectal exploration is negative, there being little or no enlargement of the lobes, the physical means of diagnosis

should be continued, entirely by the urethral route, with the aid of Mercier's short beaked rectangular metallic staff which by its reversal reveals the existence of a urethro-vesical bar or of a more or less extensive development of the lower isthmus, the thickness of which may be ascertained by the cysto-pylometer. But examination of intra-vesical projections of the enlarged prostate can be made with absolute precision only by the aid of the cystoscope with which also are detectable intercurrent phosphatic concretions, ulcerations, fleshy columns, sacculation, or new-growths.

38. The effects, immediate and remote, of prostatic enlargement require early recognition and prompt medication. Uniform general enlargement of the prostate, without encroachment upon the urethra or bladder, except in the case of malignant or tuberculous disease, gives little if any inconvenience to the affected individual who, however, if he be exposed to cold and moisture, particularly after indulging in excessive venery or drink, is likely to suffer retention of urine caused by transitory swelling of the already enlarged prostate. But this acute swelling generally yields very soon to systematic evacuative catheterism, vesical irrigation and general treatment.

39. The effects of those forms of chronic prostatic enlargement by which the capacity of the urethra and of the vesico-urethral orifice is lessened are soon felt by the bladder, that vainly struggles, for weeks or months, against the obstacle, to rid itself of foul, irritating urine. Hence the dysury, the strangury, and the consequent increase of the muscle tissue of the bladder and of the prostate itself. The stagnant, alkaline, slimy urine

affords sustenance to myriads of saprophitic and other organisms, and the resultant cystitis adds much to the distress of the patient whose pulse increases much in frequency, whose body temperature rises greatly, and in whom general septism is soon apparent. Later the inflammatory process, if not checked, creeps up the ureters, reaches the kidneys, and the sufferer succumbs to ascending microbic pyelo-nephritis. Such is the end of neglected cases of prostatic obstruction to urination. But, taken in good time, these ill effects are hindered, and some of them are counteracted, by regular evacuative catheterism, from three to five times daily; disinfecting the bladder at the same time by means of suitable irrigations. This palliative treatment is of very great value and often is the only kind indicated or even practicable. When phosphatic concretions form in the inflamed bladder, they should be destroyed before they increase much in size, and their disorganisation may be effected by daily irrigations with sterile water acidulated with hydrochloric acid. One part of the acid to four hundred parts of the water. Or their double decomposition may be assured, as suggested by Hoskins, through the daily use of abundant irrigations with a solution of lead acetate one part, acetic acid one part, and sterile water two hundred parts.

40. The treatment designed to counteract some of the ill effects of prostatic enlargement may be summarised as follows, and consists in taking suitable means to combat hyperlithuria; to empty the bladder artificially, slowly and gradually when it is much over-distended; to effect gradual hydraulic dilatation of the bladder when its capacity is lessening; to keep in check existing cys-

titis by daily vesical irrigations; to disinfect the urinary tract; to prevent calculous formation; and to endeavor to improve the general health of the patient by such hygienic and medicinal measures as may be needed. The indications for radical treatment and the divers methods of carrying out such treatment will be considered in the next series of notes.

XVI

THE ENLARGED PROSTATE; ITS RADICAL TREATMENT

1. The following preliminary notes on the early history of the operative treatment of prostatic enlargement, though very incomplete, are not without practical importance and should be carefully and heedfully studied by all beginners and by those who may invent instruments and modes of operation, in order to avoid claiming the authorship of tools used long before their time or of ancient methods which should be duly credited to their original owners.

2. The inquiry into this interesting history may properly be premised by a few more cautionary words addressed particularly to these beginners. Many physicians who have passed their third decade of professional life can bear ample testimony to the frequency with which excess of zeal has impelled enthusiastic supporters of some therapeutic invention to attempt its generalisation regardless of the varieties of morbid conditions which might contra-indicate its application. These same physicians can also tell how greatly such lack of discrimination has endangered the lives of some sufferers, and how frequently it has deprived other sufferers of the benefit of valuable devices temporarily discredited by having been untimely and unwisely used. It is hoped that this warning may prove salutary to young physicians, who, before their prescription of operative

procedures upon the prostate, will be mindful of the often iterated dictum of their teachers to the effect that the exercise of greater judgment is required to determine the kind of operation best suited to a particular case than skill in its performance.

3. Prostatic obstruction to urination, anciently believed to be caused by "excressences or carnosities," whose destruction was thought to be essential to the re-establishment of the urinary stream, was treated in accordance with the fancy that these excressences and carnosities were what is styled popularly "proud flesh," and technically granulation tissue. Their destruction was therefore undertaken by endeavoring to cause erosion of these supposititious carnosities with the aid of metallic sounds or catheters. Later, when the nature of the disease was somewhat better known, the obstacle was perforated by metallic catheters or sounds. This operation was recommended and practised by John Hunter and by Sir Everard Home, and still later by other surgeons, but was finally rejected as uncertain and dangerous.

4. Caustics were afterward largely used, or rather misused, for the purpose of destroying all obstructions to urination whether urethral or prostatic. That sort of treatment was, for some time, carried on in great excess, particularly by the followers of Ducamp, its enthusiastic apostle. Such a heroic method, as might have been expected, gave the very worst results, and at length was wisely abandoned.

5. Compression, dilatation, and depression were, at different times, the chief expedients resorted to for overcoming prostatic obstruction. Among the physi-

cians who employed these means were Physic, of Philadelphia; Leroy d'Etoilles, Meyrieux, Tanchou, and Mercier. Physic made use of hydraulic compression and retrograde dilatation of the obstructed vesical neck. Leroy, in 1825, endeavored to effect depression and compression of the prostatic outgrowth by means of a straight metallic sound, and afterward by a flexible catheter, through which he passed a rigid straight stylet. In both cases he had really pushed back the obstacle without accomplishing even dilatation as had done Physic; nevertheless his patients urinated better than before the operation, only, however, for a very short time. Meyrieux and Tanchou are reported to have used an articulated stylet which could be straightened after introduction of the catheter, and kept in position for two hours. And Mercier suggested his own rectangular sound, and also a flexible catheter large enough to admit a stout, straight, whalebone stylet, and declared that he had obtained some good results therewith, but never retained the instrument in the bladder longer than ten minutes at a time. At best, the effects of these modes of treatment were of such brief duration that their use was soon given up by the inventors.

6. Ligature of pedunculated supra-montanal prostatic tumors was suggested by Leroy, but never adopted by other physicians. Nor did the use of Jacobson's articulated stone-breaker meet with favor as an *écraseur* for the removal of such tumors.

7. Intra-vesical excision of the "third lobe" of the prostate was done by Amussat, who during supra-pubic lithotomy, detected and cut out a small tumor at the neck of the bladder. This excision and also avulsion of

such growths are still practised during supra-pubic lithotomy or even in the absence of vesical calculi.

8. Extirpation of the entire prostate, so very rarely performed, seems to have yielded the worst results. The special cases that have attracted the writer's attention are the following: It appears that total extirpation of this organ was proposed by Kuechler (Deutsche Klinik, No. 50, 1866), and later was performed by Billroth, and still later by Demarquay, who, in 1873, reported two cases of ablation of the prostate together with a part of the rectum. In the *Arch. fur Klin. Chir.*, Berlin, Vol. xxviii, 1882–83, page 578, is a paper entitled "*Tumor Prostatæ;* Totale Extirpation der Prostata," by H. Leisrink. The patient, sixty-four years of age, was suffering from the effects of prostatic obstruction. The diagnosis was malignant disease, and it was decided to extirpate the prostate in totality. The operation was done on December 24, 1881, and the patient died of exhaustion on the twentieth day thereafter. These were all cases of true prostatectomy. Until very lately, extirpation of the prostate, or of any part thereof, for malignant disease was regarded as unjustifiable by prudent physicians who sanctioned in such circumstances, only a palliative epicystotomy for drainage of the bladder.

9. Avulsion of supra-montanal prostatic tumors was early employed by Nicod, who mistaking these for polypi tore them off with forceps and thus, by this crude method, obtained some success. The accidental avulsion of "third-lobe" tumors was reported by some of the lithotomists of the seventeenth century who spoke casually of such incidents as harmless. But intentional

avulsion of prostatic growths was not in ordinary use until much later and is still practised during lithotomy or solely as a curative means of prostatic obstruction.

10. Trachœlo-cystotomy for the relief of prostatic obstruction to urination was used by Riolan, who in the seventeenth century performed the operation with success in several cases complicated with retention of urine. During the same century, Covillard combined avulsion with cystotomy; tearing away, with forceps, a tumor at the vesico-urethral orifice. In another case requiring lithotomy he repeated the process of avulsion of the growth after having extracted the stone. Sir William Blizard is cited as approving and practising trachœlo-cystotomy for the purpose of removing prostatic obstruction.

11. Enucleation of prostatic tumors during lithotomy dates only from the latter part of the second quarter of the nineteenth century. Among the surgeons who have had recourse to this procedure with intent to relieve prostatic obstruction, may be mentioned Sir William Fergusson, Mr. Cadge, Dr. Williams, and Mr. Bickersteath. This expedient has been resorted to with success by several American surgeons.

12. A brief statement of the circumstances that induced Sir William to practise enucleation of diseased portions of the prostate during the operation of lithotomy may not here be out of place. That keen-witted surgeon having repeatedly observed the same condition mentioned by old lithotomists, was, at length, led to advocate enucleation of those portions of the enlarged prostate which had so often impeded extraction of the stone, and gave his experiences in a paper, published in

The Lancet for January 1, 1870, bearing the title of "Observations on Lithotomy and on Certain Cases of Enlarged Prostate." The following is abstracted from that valuable contribution to the history of prostatic enucleation:

13. . . . "In many instances, as the forefinger passes toward the bladder, the sensation is as if its point glided through several rounded bodies, in the substance of the gland, which are but slenderly in contact with each other. . . . Repeatedly I had been conscious, during a succession of operations, of feeling and often, too, of seeing this condition. The feeling may be easily understood, but seeing can only be appreciated after explanation. When the stone is within the grasp of the forceps, there is often much resistance during extraction, even when the knife and forefinger have been freely used to give ready passage to and from the bladder. In some instances the stone, whilst all but through the wound, seems to be held *in situ*. If at this time the operator looks carefully, particularly on pushing the skin and margin of the wound a little aside, he will see some tissue or substance between the blades in the space between the hinge and stone. With a slight pressure of the point of the finger this object will disappear . . . and extraction will then be comparatively easy. This is in reality one or more of the lobules referred to. . . . On such occasions I was glad to let the substance remain without further notice. . . . After repeated experience of this sort, it occurred to me that the propriety of leaving such loosened masses was questionable; and, at last, on a tempting occasion, I seized, after the extraction, one or more of these bodies, and partly tore and

partly cut them away. To my great delight, no evil followed, and the patient, about seventy-five years old, made a most satisfactory recovery. . . . In 1848, I exhibited specimens of this kind at the Pathological Society of London. . . . I have since followed the practice . . . . whenever it seemed to me needful, and have never had occasion to regret doing so. . . . During lithotomy on a patient nearly eighty years of age . . . I recognised the hitch referred to. When the stone was extracted I turned my attention to the lower part of the prostate, and found it so loose already that I accomplished its enucleation with the point of the forefinger of my left hand, with as much readiness almost as if it had been a stone lying loose in the left lobe of the prostate. . . . His recovery was slow . . . but there has never been any irritation in the prostate. . . . When . . . the surgeon is called upon to relieve his patient from stone, and finds an enlarged prostate, why should he not . . . take away a superfluous portion of the prostate at the same time?"

14. The recorded experiences of Sir William Fergusson led the writer to adopt means similar to those of the eminent British surgeon, in the management of certain cases of prostatic obstruction when catheterism was impracticable. The subjoined note is extracted from the writer's work on "Diseases of the Urinary Organs," 1873, pp. 298–300:

15. . . . "Instead of resorting to ordinary vesical puncture after violent and unsuccessful catheterism, and after ample time is allowed for the subsidence of swelling, by drawing off the urine through capillary trocars, catheterism being still impracticable, I would pro-

pose the revival of the ancient perineal operation with the modifications described below. Sir Henry Thompson, in speaking of the old operation, says: 'This proceeding . . . appears to me calculated to be successful in those cases in which the urethra has not received any serious injury from violent catheterism. It sometimes happens, however, that from this cause false passages have been made below the prostate, constituting, in fact, the difficulty for the solution of which the question of employing a knife or trocar is entertained. In such circumstances an incision upon a grooved staff might, perhaps, lead only to embarrassment, as the urethra might still not be opened or even found.' Another objection he urges against the operation is the fear of a permanent urinary fistula. I do not think these objections tenable, because I am firmly convinced that, with care, patience, and skill, the urethra can be found without much delay in the majority of instances. Then again, experience has taught that any violence done to the urethra, at or near the prostatic portion, in old men, is more liable to give rise to abscess, in or near the prostate, and that pyæmia often supervenes in consequence. If, therefore, free egress is early given to the pus and urine through a wound in the perinæum, the danger must be very materially lessened. As for the liability to the occurrence of a perineal fistula, I am sure that such an event would be preferable to the fatal termination which is looked for in most cases treated in the usual way. In retention of urine from enlarged prostate, where violent catheterism, producing false routes, has been resorted to, the manner of proceeding should be as follows: The patient, being etherised, is placed in the lithotomy posi-

tion. A staff, with a broad groove extending to its extremity, is introduced into the urethra as far as possible. A free incision is made in the median line of the perinæum to within half an inch of the edge of the anus, involving the skin and superficial layers, then the urethra is opened longitudinally at or near the bulbo-membranous junction, and the wound extended to the apex of the prostate. Such false routes as may be found are freely laid open. A grooved director is introduced cautiously, following the upper wall of the canal; when it has reached the bladder, a catheter is passed along its groove into the bladder and the urine drawn off. . . . The surgeon should then endeavor to give permanent relief by a procedure which will not add greatly to the dangers of the preceding steps. He should first explore the prostate through the artificial opening, and if he discover a median outgrowth or isolated tumors he should dilate the prostatic sinus, or incise the prostate laterally, and enucleate the tumors, or if there be a median outgrowth, excise it; but the better plan is to remove it by means of a small wire *écraseur*, and then to introduce a large-sized soft vulcanised India-rubber catheter and retain it in position for two or three days."

16. Division of the obstructed vesico-urethral orifice, through an external perineal incision, solely with intent to re-establish the course of the urine was not erected into a regular and systematic surgical process until it was formulated by Guthrie under the title of "The division of the bar at the neck of the bladder"; but this mode of proceeding does not seem to have been generally adopted, although it was taken up on the continent by Leroy and Civiale, who, however, did not follow it long.

17. Internal division and also excision of the central part of the urethro-vesical barrier by the way of the urethra, began with Mercier, who after carefully studying the divers operative methods employed up to his time, was led, in the year 1837, to devise an instrument for excising these barriers and thus make a channel through which the urine could be more freely expelled. Having tried it several times on the cadaver, and not being satisfied with its action, he produced three others of which two were for incision and one for excision, but gave them no name other than incisor and excisor of valvules of the neck of the bladder. The writer (in 1878) adopted for them the names of prostatotome and prostatectome, and for the operations, prostatotomy and prostatectomy. These instruments are not unlike lithotribes and are similarly introduced for action.

18. Electro-cauterisation of prostatic growths obstructing the vesical outlet was proposed and practised by Bottini, about thirty-five years ago, as a substitute for Mercier's operations of incision and excision of valvules of the neck of the bladder. But the results obtained from the Italian method of cauterisation do not seem to have been satisfactory to many of those who have since employed it or its modification by Freudenberg.

19. The preceding notes embody such facts as have been gathered from divers sources of information relating to the early history of the operative treatment of prostatic enlargement. The next question in order is the examination of the present therapeutic management of this serious ailment, a brief statement of which will be embraced in the following notes.

20. It is clear that very many, but assuredly not all, cases of prostatic enlargement causing retention of urine require radical operations; long experience having shown that in a fair proportion of cases, this enlargement is only transitory, often due to inflammatory action, or to œdema, seated chiefly in the vesico-urethral region and relievable by a few evacuative catheterisms; an occurrence by no means uncommon in those cases of uniform general enlargement without obstruction to urination, and giving no inconvenience whatever until exposure to cold or debauch in wine or in venery causes acute retention of urine from swelling and temporary closure of the vesical outlet. Radical interference is therefore indicated solely in cases attended with permanent inability to empty the bladder, and even in some of these, that is to say in cases of long standing, with seriously damaged bladders, ureters, and kidneys, only palliative measures are allowable. The main obstructions at or near the vesico-urethral orifice being permanent contracture, a simple "bar," local increase in bulk forming the so-called "third lobe" of the prostate, it would not seem reasonable, even to the uninitiated beginner, that an exclusive method of treatment should be applied to all such conditions whose divers phases and existing complications, aside from the actual physical state of the sufferers, surely merit the most serious consideration. A critical examination of the characters and claims of the many operative methods that have been proposed for the removal of these obstructions to urination would doubtless be very interesting, but it suffices, for the present, to summarise the nature, indications, and contra-indications of the

chief processes now in use, namely: internal prostatotomy, external prostatotomy, electro-cauterisation of the prostate, avulsion of portions of the prostatic lobes, and enucleation in mass of the diseased parts in "senile enlargement."

21. Internal prostatotomy is effected by a deep median incision of the inferior lip of the urethro-vesical orifice involving also the diseased part of the prostate, made by projecting a blade concealed in the rectangular beak of an instrument introduced by way of the urethra. This operation, so often and so successfully performed by Mercier, is indicated in cases styled by Guthrie "bars at the neck of the bladder," and by Mercier, prostatic "valvules," which do not generally exceed five millimeters in thickness, and in permanent contracture of the vesical neck. In these cases of "bar" and of "valvule" there is very little prostatic enlargement, and none whatever in permanent contracture of the neck of the bladder, but all these conditions so impede urination as to demand radical interference. Of the several instruments devised to effect this internal incision, those of Mercier appear to be the best, particularly the model which is designed to grasp tightly the "valvule" before it is cut, and so render the operation almost bloodless. Not content with the mere incision, which he sometimes found to be insufficient, he used another instrument for punching out a piece of the "valvule" with the object of forming a broad and deep central gutter for exit of the urine. Internal prostatotomy is of no use whatsoever in cases of large "third-lobe" tumors, particularly those associated with lateral-lobe enlargement.

22. External prostatotomy was performed, in the year

1880, by the writer, through an external perineal urethrotomy in the membranous region. In the same year he performed external prostatectomy. In one case of external prostatotomy he used Mercier's incisor and later, in another case, made the urethro-vesical incision with a straight, probe-pointed bistoury. In three cases of external prostatectomy he twice used Mercier's prostatectome, and once an instrument of his own. External prostatotomy was suggested by observation of the good effects of perineal cystotomy for the extraction of calculi; a fact long known to lithotomists who had noticed that obstruction to urination, so often the result of calculous cystitis with urethro-vesical contracture, was removable by the incision made for the withdrawal of a stone. So, external prostatotomy is probably as old as lithotomy. It would seem strange for any modern surgeon to entertain reasonable doubts of the propriety of an external operation in cases of permanent urethro-vesical contracture or of prostatic "valvule," even in those uncomplicated by the presence of a calculus or of a foreign body. This operation could not well be objected to on the score of danger from hæmorrhage which would be much more easily controlled than in the case of the internal incision. External prostatotomy is decidedly contra-indicated in cases of large "third-lobe" tumors.

23. The after-treatment, in the case of these internal and external operations, has for its chief object the retardation of the process of cicatrisation of the urethro-vesical wound, to effect which, and also to secure a wide outlet for the urine, dilating instruments are used at very short intervals.

24. Electro-cauterisation, after the Bottini-Freudenberg method, is too generally performed without regard to the extent of enlargement of the prostate or to the remote effects of the burns inflicted upon the prostatic urethra. The more conservative upholders of this operation, however, give it their approval only in cases of "bars," of very small "third-lobe" tumors, or of vesico-urethral contracture, and condemn it in cases of very great prostatic enlargement and of far advanced disease of the kidneys. Still, this method of treatment does not appear to possess any advantage over Mercier's processes, and is open to the objection of causing stenosis of the prostatic urethra by the subsequent cicatricial contraction, as after burns in the third degree.

25. Avulsion of portions of the "third-lobe" and of the lateral lobes of the prostate through a supra-pubic cystotomy, performed by McGill and by several Americans during the past eighteen or twenty years, does not appear to be founded upon sound surgical principles and is open to many objections that need scarcely be stated in this place, since they have already been so forcibly urged by competent observers and writers. It is enough to say that this operation leaves ragged denudations which only serve as habitations for pathogenic organisms, and is not likely to remove completely the obstacle to urination. Through the same epicystotomy, enucleation of the "third-lobe" can be effected at least as quickly as its piecemeal avulsion whose justification is more than questionable in consideration of the later advances in prostatic therapy. But there were surgeons who, instead of avulsion, practised excision of the growth by the supra-pubic route. A urethro-vesical

tumor was so excised during supra-pubic lithotomy by Amussat in the early part of the nineteenth century. Excision was done through the same route by Dittel, in the year 1885, and by Belfield in 1886, both of whom, however, employed the epicystotomy not for extraction of a stone but for the sole purpose of removing the obstructing portion of an enlarged prostate. It has already been stated, in a prior note, that the removal, by the lower route, of intra- as well as extra- vesical protrusions of the enlarged prostate, mainly by enucleation, has been accomplished many times with excellent results by the lithotomists of the seventeenth and eighteenth centuries, and in our times, by the most eminent British and American lithotomists, immediately before, or during, or after the perineal extraction of vesical calculi. It is partly from an examination of the published acts of these operators and of the results of the operations performed in the course of three centuries that was evolved the radical and rational operation of enucleation in mass of the diseased glands in the lobes of the prostate by the perineal route.

26. Enucleation of portions of the prostate—not incident to lithotomy—belongs to the closing years of the nineteenth century. This operation has been wrongly styled prostatectomy,* which means literally and strictly the cutting out of the prostate, whereas the real act is in truth the enucleation of a mass or of masses of diseased prostatic mucous glands together with their network of connective and muscular tissues. When such enucleation is effected, there may be still left some glandular substance besides the superficial layers of

* The writer pleads guilty of this inexactitude.

muscle tissue of sufficient thickness to be discerned by digital rectal exploration several months after the operation; so it is plain that the whole of the prostate is not removed by this process of enucleation, nor is it thereby removable. The only method deserving the name prostatectomy is that as advocated by Young, who includes the capsule and even a part of the bladder, of the seminal vesicles, and of the spermatic canals in its extirpation for cancer.

27. Enucleation of diseased prostatic glands is indicated in those cases commonly styled senile enlargement, provided the upper urinary organs are not seriously damaged; otherwise, it is absolutely contra-indicated. It is also contra-indicated where there is no increase of the lobes but simply a thin urethro-vesical "bar or valvule." The operation was performed by Nicoll, of Glasgow, in the year 1894, and afterward by Alexander, of New York. Nicoll enucleated the diseased lobes through a median perineal incision without opening the urethra, whilst Alexander incised the whole of the membranous region of that canal. Nicoll relied entirely upon supra-pubic drainage after the operation, but Alexander preferred perineal drainage. Both resorted to epicystotomy for the purpose of introducing one or two fingers into the bladder to steady the prostate during the process of enucleation. This complicating epicystotomy has been rendered unnecessary by the use of Syms' bulbed India-rubber tube, of the tractors of Lydston, of Albarran, of de Pezzer, of Proust, and of other like instruments since devised to steady the prostate during its enucleation. Some operators employ these tractors under the erroneous impression that they

do more than steady the parts, that they drag down the practically immovable prostate so firmly held in position by its strong pubic ligaments.

28. A few words now respecting the means employed to approach the prostate for the purpose of enucleating its diseased glands. The lateral incision continued to be employed by the followers of Fergusson, whilst Nicoll, Alexander, Syms, Watson, and Goodfellow use the median cut suggested by the writer. Other operators advocate the crescentic Celsian incision adopted by Dupuytren for bilateral and by Nélaton for prerectal lithotomy, thinking to bring the prostate into view and within easier reach than do the many varieties of the same cut as practised by divers surgeons, and so facilitate and expedite enucleation in mass of the diseased glands; always, however, striving to spare the sphincter muscle of Wilson, which need not be seriously disturbed during the operative process.

29. The operation, either by the median external incision with lateral intra-urethral cuts and finger enucleation, or by the crescentic external wound or any of its varieties, with division of the prostatic capsule, is accomplished, in the first case, in fifteen minutes, and in the second case, in twenty or thirty minutes, while the patient is in the lithotomy position and under anæsthesia.

30. The chief instruments needed are: a scalpel; a grooved staff; a broad-grooved director; thumb forceps; retractors; artery clamps; a tractor to steady the prostate during enucleation; a blunt-edged dissector; broad-beaked fenestrated forceps; lithotomy forceps; a large-calibered India-rubber catheter; curved needles; and an irrigation apparatus.

31. The steps of the operative method published by the writer in 1873 and since modified slightly, are substantially as follows: A steel staff, grooved down to its extremity, is introduced, a median perineal incision made, and the membranous urethra opened lengthwise. This is succeeded by the passage of a broad-grooved director to guide the knife with which a cut is made on each side of the prostatic urethra. The index finger is then introduced and enucleation of each lobe is rapidly made. The "third lobe" enlargement is attacked in a somewhat different manner: the grooved director is reintroduced to guide the knife to bisect the outgrowth which is then enucleated as were the lateral lobes; but if the cystoscope had shown this third lobe tumor to be pedunculated, it is at once excised or its peduncle is crunched with a wire *écraseur* and the growth extracted. The full details of the procedure have been given, and comments thereon made by Watson, Goodfellow, and others who have performed the operation with good results. Up to the year 1904, this rapid intra-urethral finger enucleation of the diseased prostatic lobes had been performed by Goodfellow seventy-four times with but two deaths.

32. In this note, no attempt is made to describe the divers ways of operating by the perineal route for the relief of prostatic obstruction devised since the time that Sir William Fergusson effected enucleation of tumors of the prostate during lithotomy. But a composite sketch is undertaken which embodies the main features of some of the methods in actual use as follows: The rectum having been emptied and cleansed and the bladder and pudendum disinfected, a grooved staff is introduced and

held in proper position by the chief assistant. A perineal crescentic incision is then made, the membranous urethra and under surface of the prostate exposed as in Nélaton's prærectal lithotomy, the urethra opened lengthwise close to the prostatic apex, the staff withdrawn, and the tractor passed through the wound into the bladder. The prostate is thus brought to view and thrust forward as much as practicable by the skilful management of the tractor. Some surgeons regard the metallic tractors as unsafe and prefer using Syms' India-rubber tractor. The next step is to incise the prostatic capsule longitudinally on its lower surface about six millimeters from the median line on each side as practised by Young. These incisions, beginning at five millimeters from the apex, may be of the length of fifteen millimeters or more, according to the size of the diseased prostatic body. The enucleation is made partly with the finger, partly with a blunt-edged dissector, or even with scissors. The diseased portion of a lobe, as soon as loosened anteriorly, is seized with a broad-beaked fenestrated forceps, such as that used by Young, and with it moderate traction is made until the process of enucleation is completed. The diseased mass on the opposite side is treated similarly, and so is the "third lobe." Finally a large-sized, soft India-rubber catheter is passed through the cut into the bladder, the cavity of the wound loosely packed with gauze, the horns of the crescentic incision stitched, and the catheter kept in position three or four days for vesical drainage. Such are the essential features of some of the present operative methods for the radical treatment of prostatic obstruction.

33. Severe hæmorrhage is of very rare occurrence in any of the internal or external operations upon the prostate. Mercier, in his long experience, said that he had seldom had to cope with profuse bleeding, which he always succeeded in arresting, but other French surgeons of his time reported some deaths from this cause. The writer had two cases in which the hæmorrhage was abundant. One was an internal, the other an external prostatectomy. In the first the bleeding was promptly checked and the patient recovered, but the second case proved fatal.

34. Consequent upon perineal enucleation of the prostate are certain occurrences which are noteworthy, namely: injury of the rectum, an accident to be guarded against in exposing the prostate and during its enucleation; lacerat on of the prostatic urethra which, however, causes no subsequent trouble if the mucous membrane has not been torn away; detachment of the urethra from its prostatic junction when undue force is employed in the process of enucleation, requiring prompt means to prevent stenosis; injury to the sphincter muscle of Wilson, which causes incontinence of urine lasting from three weeks to three months or even for a much longer time; this, however, is by no means a constant occurrence, and needs no special attention other than to secure cleanliness and protection of the garments; and occasionally spasmodic contracture of the bladder, due to the three or four days' retention of the perineal drainage tube, and remedied by the gradual hydraulic dilatation of this viscus. The main advantage of enucleation is the complete removal of the obstruction to urination. The risks of the operation are no greater than those of

lithotomy or of urethrotomy, and the convalescence is no longer than that from either procedure. The good results obtained by the many hundreds of surgeons, at home and abroad, who have since performed this operation, speak well for enucleation by the perineal route, unaided by epicystotomy.

35. The after-treatment, too often neglected, in cases of supra- and infra-pubic prostatic operations, should be directed chiefly toward the prevention of calculous formation. This common sequel is averted by frequent irrigations of the bladder so soon as the supra-pubic vesical wound is firmly consolidated, and, in the infra-pubic operations, some time even before cicatrisation. The character of the urine, tested every day, indicates the kind of irrigating fluid to be used. When the urine, though purulent, is but moderately acid or neutral, a simple mild disinfectant suffices, but when alkaline and loaded with phosphatic crystals, long continued daily washings of the bladder with Hoskins' acetic acid and lead acetate solution effect the double decomposition of the phosphatic salts as fast as they occur. By this simple treatment the cystitis is soon relieved, and at length the bladder very nearly regains its wonted suppleness and activity. So far as known there is no surer or safer way to prevent phosphatic gravel after operations on the prostate.

XVII

THE BLADDER; ITS INJURIES

1. The urinary bladder hidden behind a strong, bony casing and thick abdominal parieties, is subject to serious injuries, prone to retain entering foreign bodies, and liable to divers painful disorders. These accidents, as well as certain affections such as new growths, phlegmasiæ, contracture of the muscular wall, hæmorrhage from the mucous membrane, sacculation, and calculous concretions, are the main morbid states of the organ which require the surgeon's mediation.

2. Before taking into consideration the nature and treatment of some of these conditions, it will be profitable to cast a rapid glance at certain anatomical features and relations of the bladder, a just appreciation of which can scarcely fail to afford the most valuable guidance to the surgeon in his operations.

3. This musculo-membranous pouch, bound by connective tissue, throughout the extent of about half of its base, to the lower end of the rectum, rises upward and forward to the pubic symphysis. Its shape, in the state of vacuity, is that of an isosceles triangle whose apex is at the top of the pubes; and in the state of plenitude it assumes an ovoid form and mounts above the pubes. Its average capacity is eighteen ounces, but it is capable of very great distension even when diseased. In infancy it is almost an abdominal organ.

4. For practical purposes the bladder is divisible into four regions: the summit, or upper fundus; the body, which is intermediate; the base, or lower fundus; and the neck, whose center is the urethral opening. The upper fundus and body are of import to the surgeon chiefly in connection with their injuries and their sacculation, and with epicystotomy. The lower fundus is divided into two segments, one of which occupies an equilateral triangular space whose anterior angle is at the vesical outlet, and whose posterior angles, which are three centimeters apart, correspond to the ureteric orifices. The base of the triangle rests against an interureteric thick muscular band styled the muscle of the ureters, and forms the boundary line between the two segments of the fundus. This triangular space, thicker and richer in vascularity and innervation than other parts of the organ, lies upon the seminal vesicles by which it is separated from the rectum. It was originally described by Lieutaud,* who recognised its great vascularity and sensitiveness, and who named it, from its outlines, the vesical trigone. The posterior segment of the fundus is liable to great expansion from the accumulation of urine, particularly in the case of prostatic obstruction, and, owing to its lesser sensitiveness, is the natural habitat of calculous concretions repelled by the irritable trigone

5. Of the five vesical coats, the incomplete peritoneal layer covers the upper fundus, about one-third of the lateral surfaces, the whole of the posterior surface and

* *Joseph Lieutaud. Observations anatomiques sur la structure de la vessie. Mémoires de l'Academie Royale des Sciences*, 1723. Weslin also described the trigone, but thirty years (1753) after Lieutaud.

a variable extent of the lower fundus. . . . It sometimes, though very rarely, happens that the peritoneal layer of the upper fundus extends so far down the anterior surface as to be exposed to the knife's edge in the performance of supra-pubic cystotomy. Two instances of injury of the peritonæum during epicystotomy came to the writer's knowledge. The operators did not become aware that the serous layer had been incised until after the operation, when knuckles of small intestine were extruded from the wound. Another freak of the peritonæum, as described by Isaacs, is to cover the whole of the lower fundus and sometimes to overlap the base of the prostate, and thus seriously complicate recto-vesical puncture and lithotomy. . . . Next to the peritoneal coat is a complete elastic fibrous investment continuous with the sub-peritoneal connective tissue beneath which is the coat of smooth muscular tissue * in three superposed layers; the external layer being practically longitudinal, the middle transverse, and the internal reticular consisting largely of longitudinal bands extending from the summit to the neck of the bladder and serving to open it in the act of urination. . . . It is chiefly this reticular layer which, by its increase, forms these fleshy columns that result from the straining efforts made to expel the urine in cases of urethral and prostatic obstruction. . . . The intermediate circular layer exends to and beyond the neck of the bladder and forms its sphincter, demonstrated by Sappey as seated at the base of the prostate. . . . Although the existence of this sphincter is admitted by physiolo-

* The muscular structure of the bladder was described by Rousset during the last quarter of the sixteenth century.

gists, they deny that its action is of sufficient power to repress urgent urination, and declare that it is solely by virtue of its elasticity that it keeps the vesical outlet closed as other sphincters keep closed the outlets which they guard. These physiologists teach that the true sphincter muscle described by Wilson as made up almost entirely of striped fibers and seated in the membranous region o the urethra forms the real barrier to the escape of urine, and that being under the control of the will, it alone can repress the urinary flow. . . . The fourth is the sub-mucous coat, made up of loose connective tissue with an abundance of elastic fibers and the rich plexus of venules described by Gillette. . . . The fifth or mucous coat, surmounted by a polymorphous epithelium, is the thinnest of the complete coats and contains but few lymphatics or mucous follicles except at the anterior extremity of the trigone.

6. Normally, the thickness of the empty bladder's walls, in the adult male, is about seven millimeters and decreases to three millimeters in the moderately distended organ. When the bladder is empty, its mucous membrane is in a rugous state, except at the trigone, where t is more adherent and always retains its smoothness; but when the organ is full the mucous membrane is smooth throughout, and, viewed after death, this membrane is nearly white in young children, grayish in adolescents and adults, and pinkish in elderly men. During life, as revea'ed by the cystoscope, it is of a decidedly pink hue, in adults, and exhibits a few branching blood-vessels.

7. The innervation of the bladder is derived from the hypogastric plexus of the great sympathetic and from

the sacral plexus of the spinal system. So that in case of injury or disease of the great nerve centers, by which sensation is abolished, the organ is very soon distended with urine and the sufferer, though he recover consciousness and is sensible to pain, is not able to accomplish the act of urinat on even after the bladder has been relieved by the catheter. This condition is due to the over-distension of the walls and the great stretching of the nerve twigs and of the muscular coat, the recovery from which is very slow and tedious When, however, the organ is completely paralysed there is real incontinence rather than retention of urine.

8. The blood supply of the bladder comes from the pervious parts of the umbilical arteries which send off superior, middle, and inferior branches, from certain inferior vesical branches of the internal iliac arteries to nourish the lower fundus the prostate, and the seminal vesicles, from inferior branches of the middle hæmorrhoidal arteries, and from anterior and lateral branches of the obturator and internal pudic arteries.

9. The vesical veins, which have been carefully studied by Gillette, form three distinct plexuses; a sub-mucous, an inter-muscular, and a sub-peritoneal plexus. The sub-mucous plexus consists of venules arising from the capillary network of the mucous membrane. The meshes of this network are much closer in the lower vesical fundus than in other parts of the bladder and are superposed. In the trigone and around the vesical outlet the network is richest. To this great vascularity are due the free hæmorrhages which occur often from careless catheterism and from lithotrity. The intermuscular plexus is formed partly from the venules of the muscular

layers, but mostly from the sub-mucous plexus. The sub-peritoneal plexus is made up of satellite veins descending from the upper to the lower vesical fundus. The anterior of these veins, which end in the plexus of Santorini, sometimes cause troublesome hæmorrhage during the early steps of supra-pubic cystotomy.

10. The injuries of the bladder comprise incised, punctured, stab, lacerated, and shot wounds, besides rupture of its walls. The organ is liable to be injured in any of its several regions.

11. Incised wounds of this viscus, except those made with therapeutic intent, are of very rare occurrence. Nevertheless, in not a few instances, during operations performed upon abdominal and pelvic organs, the edge of the surgeon's knife has accidentally made its way into the bladder; and once a piece of the vesical wall was inadvertently cut away together with an adherent mass of new growth. Such accidental wounds of the body or upper fundus demand first the thorough cleansing of the surrounding parts and the immediate suturing of the wound. Any great delay in such medication very materially decreases the chances of recovery.

12. Of punctured wounds, the only illustrative case which has come to the writer's knowledge is that of the sailor—mentioned in note 15, xiv—who, tormented by urinary retention, punctured his bladder through the rectum with a marlinspike and recovered! Puncture by impalement has occurred, though in very exceptional instances. A case of this sort was related by a surgeon who had been called to lithotomise a patient, and who, finding the extracted phosphatic calculus to have for nucleus a piece of wood, made inquiry into his previous

history, and learned that, several months prior to the operation, the man had been accidentally impaled by a sharp stick of wood, and that the parts had healed after giving vent to urine for some time. From this account it was evident that the impaling stick had entered the lower vesical fundus and had left behind the bit of wood to become the nucleus of the stone. Another case of vesical wound by impalement is recorded in Professor Paul F. Eve's *Collection of Remarkable Cases in Surgery*, under the head of "A red-hot poker thrust through the bladder of a young man; recovery"; and was translated from Chopart's *Maladies des Voies Urinaires*, into which it was admitted from a collection of cases published by an Edinburgh society. "In March, 1735, a blacksmith thrust into a young man aged 20, a red-hot iron which entered about an inch and a half from the anus, passed through the pelvis, and came out in the linea alba just above the pubes. . . . Forty-eight hours after being wounded, he had not passed a drop of urine, notwithstanding the great quantity of drink he had taken . . . Urine and feces afterward passed out at the lower end of the wound. . . . In ten days the actions of the bladder and rectum were resumed . . . and in six weeks he was cured." It is clear that the patient was saved from infiltration of urine in the pelvic connective tissue, owing to the cauterisation of the whole tract of the wound made by the impaling hot iron.

13. Of stab wounds, a fair example is that related, in note 15, xiv, of the seafarer who plunged a sharp knife into his bladder, a little above the pubes, to be relieved of retention of urine, and who recovered from the injury

notwithstanding the ensuing urinary infiltration of the neighboring connective tissue. The erudite surgical historian of the American civil war of 1861–65, George A. Otis, U. S. Army, in his article on *Punctured, incised, and lacerated wounds of the bladder*, said that "no sword, lance, or bayonet wounds involving the bladder were reported, and the only cases belonging to this group were examples of punctures of the bladder for retention of urine, or of cystotomy with a therapeutic purpose," and regarded accidental wounds of the bladder as rare.

14. Lacerated wounds of the bladder are well exemplified in a case reported by Prescott Hewett, *Lancet*, 1847. "The patient, forty-seven years old, when received in St. George's Hospital, was in a state of collapse owing to a severe injury inflicted by accidental impalement. He had slipped off a table upon which he stood and in his fall had knocked over a chair, one of the legs of which had entered his rectum and bladder. Catheterism brought out a quantity of bloody urine. . . . He died in about twenty-one hours after admission to the hospital. The necropsy revealed a large, lacerated wound in the forepart of the rectum, through which two fingers were easily passed into the lower vesical fundus, and another extensive laceration was found at the right side of the upper fundus leading into the peritoneal cavity which contained a large quantity of bloody fluid mixed with recently effused lymph."* No better example than this could be given of the fatality of severe vesical wounds, especially when double or multiple and involving the peritonæum. Doubtless it was the close observation of the progress of such injuries that led the

* Eve, loc. cit. p. 359.

Father of Medicine to compose the aphorism in which all that he said of the fatality of severe vesical wounds should be taken at its true meaning and not as too often misconceived to signify that *all* wounds of the bladder were anciently believed to be deadly The great master of medical art, knowing perfectly well that all bladder wounds do not necessarily kill, simply wrote *severe* wounds of the bladder are deadly. His able commentator Galen said that the term used by the author signified a great or severe wound, and that the epithet *deadly* was often employed in the sense of very dangerous.

15. Shot wounds of the bladder even when not involving other important parts, are all attended with danger, but in unequal degrees; for instance, the large wounds inflicted by the old musket balls were often lacerated and allowed a great quantity of urine to gush into the pelvic connective tissue or into the peritoneal cavity, otherwise the ball dropped in the bladder to become the nucleus of a phosphatic stone; whereas the missile discharged with great velocity from the modern rifle makes practically a punctured wound and so condenses the connective tissue along its whole tract that no infiltration of urine is likely to occur. But even the unspent conical Minie ball has passed through and through the bladder without doing any other mischief. The following remarkable case of recovery from a shot wound through the bladder was reported, in 1853, by Dr. Palmer, of the East India Company's service. The victim was a woman who was accidentally shot while crawling on her hands and knees. The bullet which had entered her body about one inch from the right side of the anus, was found imbedded in the loose tissues on

the right side of the navel. "In its course it had penetrated both the bladder and uterus. . . . A bloody discharge, mixed with urine, flowed freely from the wound for three or four days, when it ceased altogether. . . . In three weeks she was restored to perfect health."*

16. Recovery from shot wounds through and through the bladder is sometimes very rapid, particularly when the peritonæum is not involved, as in Liddell's and other surgeons' patients referred to by Otis in his exhaustive article on shot wounds of the bladder.† In Liddell's case the ball entered at the left of the hypogastrium and emerged from the right buttock; the urine escaping from the point of entrance. A similar case, occurring in the practice of Van Buren, is also recorded by Otis. Likewise Hamilton's case, in which a rifle ball entered above the pubes. He cites four additional cases, one of which was "an oblique perforation of the pelvic cavity by a ball entering in the right inguino-hypogastric region, passing through the bladder, and emerging through the sciatic notch; the patient making a satisfactory recovery." Another instance of recovery after shot perforation of the bladder is related at page 488 of the first surgical volume. The early history of a good example of recovery is given from the report of Dr. Rankin. The ball had entered at the left iliac region, probably perforated the fundus of the bladder, and emerged at the right buttock. A recovery from such a bladder wound was reported by Dr. J. D. Jackson. Nearly all of these seven cases of shot perforation of the bladder very quickly recovered without serious

* Eve, loc. cit. p. 359. † Loc. cit. Vol. II., part II.

complications, owing chiefly to their being punctures in effect.

17. A fair conception of the immediate and remote effects of the generality of shot wounds of the bladder may be formed from a glance at the summary of the reports made by field and hospital surgeons during the American civil war, as given by Otis, who said that "in one hundred and eighty-three reported cases, eighty-seven patients, or 47.5 per cent., survived; though a large majority suffered from grave disabilities, and many from distressing infirmities, which have resulted fatally in a few cases after years of suffering."

18. The treatment of such injuries is generally very simple, for, beyond extraction of the bullet when lodged within reach, the essential requirements are rest in the horizontal posture, suitable drainage, cleanliness, and a light dressing of the wound. Probing and other meddlesome interference can only serve to do mischief and perhaps cause serious infection of the wound. In those cases of lodgement of the missile in the bladder, cystotomy as a secondary operation becomes necessary for its safe extraction. But when a shot or any other wound of the bladder is known to involve the peritoneal cavity, the abdomen should at once be opened in the median line, the intestines examined in the tract of the wound and appropriately dealt with, the blood, urine, and excreta washed out and the vesical wound immediately trimmed and stitched; the final step being the closure of the exploratory abdominal incision.

19. Rupture of the bladder claims the closest attention of the observer on account of the great importance of its early diagnosis, generally attended with so much

difficulty, and also on account of the imperative necessity for prompt surgical interference as the only means of materially lessening the woeful mortality, from this rare accident, which happily has been thereby marvelously decreased as shown by comparison of its death rate, for a period of sixty years, down to 1851, collated by Stephen Smith,* and the figures given by others in 1882 and 1903. Out of Smith's seventy-eight cases, seventy-three died, and only five recovered; whilst thirty-one years thereafter, in 1882, Bartels collected one hundred and sixty-six cases, of which one hundred and forty-nine died, and seventeen recovered; and, in 1903, Jones reported fifty-four cases, of which twenty-six died, and twenty-eight recovered. This decrease in mortality appears to be due chiefly to a diagnosis made early enough, in a fair proportion of cases, to permit the application of modern methods of treatment. Until the end of the third quarter of the nineteenth century, intra-peritoneal ruptures were generally believed to be beyond remedy. The distress of the sufferers was soothed by opiates and the hour of death sadly awaited! Of so rare occurrence is rupture of the bladder, or so seldom, formerly, was it diagnosticated, that down to 1851 the profession of the whole world had supplied reports of cases by only forty-two writers, in the course of sixty years; whereas from 1851 to 1906, more than two hundred contributions were made to illustrate the diagnosis and treatment of this lesion.

* A contribution to the statistics of rupture of the urinary bladder; with a table of seventy-eight cases. By Stephen Smith, M.D., assistant surgeon to Bellevue Hospital, N. Y., New York Journal of Medicine and the Collateral Sciences. Volume VI, New Series, March, 1851, pp. 336–375.

20. The researches of statisticians regarding sex and age show that vesical rupture occurs less frequently in females than in males. Only eleven cases of rupture of the female bladder are noted among the seventy-eight cases in Smith's table. This disproportion is ascribed to difference in pelvic configuration, in habits, in occupation, etc. Then, too, men are much oftener exposed to injury than women. The statisticians have also examined the question of age and show that the time of life at which the injury is most liable to occur is during the period of greatest bodily activity when men are more frequently exposed to violence. Thus the accident happens oftener to men between the ages of twenty-five and forty; very rarely in childhood and still more rarely after the age of fifty-five. Not a single case occurring at the age of sixty is recorded by Smith. Other writers have reported cases of this injury in patients of sixty and upward. As to the other extreme of age, the instances are few. Harrison, in the Dublin Journal of Medical Science, Vol. XI, gives the history of a boy two years and a half old who was run over by a cart wheel and lived ten days. The rent was in the anterior vesical wall. In the Charleston Medical Journal, Vol. V, is to be found a record of Pendleton's case of a boy seven years old who was trodden upon and died on the fourth day. The rupture was intra-peritoneal; the abdomen containing two gallons of fluid. The case of bladder rupture, in a girl five years old, related by Robinson in *The Lancet* for January 23, 1904, is mentioned by Horwitz in his paper published in the December, 1905, number of the Annals of Surgery. An account by Cooper, in the Guy's Hospital Reports,

Vol. II, 1844, is given of a girl aged nine years who was run over by a cart and died on the second day. There were three rents in the bladder. Three of these four instances were taken from Smith's table.

21. Rupture of the bladder may be the result of direct or of indirect violence; of straining to relieve the distended organ; of parturition, or of pressure by a uterine displacement causing retention of urine; or of violent contraction of the abdominal muscles upon an over-distended bladder. Of direct violence, Smith tabulates fifty-seven cases; of indirect violence, seven cases; of straining to pass urine, the bladder being distended owing to obstructing urethral stricture, five cases; of distension of the viscus during parturition, four cases; of distension from uterine retroversion, one case; and in four cases the cause is not stated. In relation to the site of the rupture, it may be worth noting that, of the seventy-eight tabulated cases, sixty-four of which were stated with precision, the rent occurred through the posterior wall in only eleven cases; whilst it was found in thirty-four cases at or very near the vesical summit which rises so high up above the pelvic brim, during great distension of the organ, as to escape direct contact with unyielding structures. At the fore part of the bladder rupture occurred in nine cases; at the sides, in five cases; and at or near the neck, in five cases. It may be interesting to note that in thirty of these seventy-eight cases the rents ranged from three millimeters to five centimeters in extent, and that in nine instances only did they exceed five centimeters; four of these nine cases being stated respectively as large, very large, throughout the whole extent, extensively

lacerated. In the rest of the cases the degree of laceration was not clearly indicated. One of the most extensive of lacerations is that figured by R. W. Taylor. It occupied nearly the whole posterior vesical wall in three radiating rents.

22. Of urethral stricture as the remote cause of rupture of the bladder, besides the five cases cited by Smith, three more cases may be recorded; one originally related by Home and mentioned by Cruse;* one in the writer's service at Bellevue Hospital; and one by A. V. Williams.† Other cases have since been reported in which urethral stricture was the remote cause of the rupture.

23. Of straining to relieve the over-distended bladder as the direct cause, stricture being the remote cause, of its rupture, the following is a fair example: A man, thirty-six years of age, suffering from urethral stricture with urinary retention, felt "something give way within him," while straining to pass water, two days before his admission to Bellevue Hospital, but was able to walk and call upon a physician who catheterised him and drew off one hundred and eighty grammes of urine. When he entered the hospital, he had passed no urine for forty-two hours. The abdomen was then tympanitic, painful, and tender to touch. Through a small catheter, one hundred and eighty grammes of urine flowed without, however, giving relief to his suffering. . . . Meanwhile, the stricture was dilated to No. 9 (English) catheter which was retained in position from the seventh to the eleventh day, when it was withdrawn on account of the ensuing urethral and vesical irritation, but was

* Medical Record, Vol. VI, No. 11, Aug., 1871.

† New York Medical Times, January, 1855.

reintroduced on the same day owing to a sudden pain in the bladder and the escape of a little blood. An indurated and painful mass in the lower hypogastrium was detected on the twelfth day. Twenty-four hours thereafter, the patient had a rigor followed by high body temperature and sweating. . . . The mass in the hypogastric region softened, pointed toward the right inguinal ring, was freely incised, on the twenty-ninth day, and discharged an abundance of fetid pus and urine. He then failed steadily and died on the forty-sixth day. The post-mortem examination revealed septic pyelo-nephritis and intense cystitis. . . . . There was a rupture in the anterior vesical wall a little to the right of the median line. The opening in the mucous membrane was somewhat rounded and admitted the index finger. The muscular and fibrous coats showed a vertical rent two centimeters and a half in length. The adjacent tissues, down to the rectum, exhibited the ravages made ordinarily by decomposed infiltered urine. Nature, in this case, had striven to do what the surgeon's knife should have accomplished had it been early used.

24. A striking example of rupture of the over-distended bladder by violent contraction of the abdominal muscles during powerful efforts to resist anæsthesia, is worth another notice for what it teaches, although it was recorded in Cruse's paper and in the writer's work on Diseases of the Urinary Organs, 1873. The patient, sixty years old, was able to walk up to his ward in the hospital, saying that he had passed no urine for three days, but would give no further information. The bladder was greatly distended. The perinæum, scro-

tum, and penis were of a dusky red and much swollen from urinary infiltration which had occurred twelve hours from the beginning of the retention. . . . Exploration of the urethra by the house surgeon led him to the belief that the obstacle to the passage of bougies and catheters beyond the perineal region was of the nature of a stricture, and to the determination of making a more thorough exploration with the aid of anæsthesia which, as soon as administered, caused the patient to become greatly excited and to struggle violently, when suddenly the hypogastric tumor disappeared and the former area of dulness became tympanitic. Catheterism again failed. There was no sign of collapse. Four hours later the integuments of the penis and scrotum were freely incised and suitably dressed. From that time the patient made no motion or sound to attract the attention of the nurse, who found him dead four hours after. The post-mortem examination revealed a complete rending of the urethra near its bulbo-membranous junction, evidently the result of a severe perineal contusion, and this accounted for the retention and extravasation of urine. At the posterior part of the upper vesical fundus was a laceration thirteen millimeters in length through which two liters and a half of bloody urine had escaped into the peritoneal cavity. Had supra-pubic capillary puncture and aspiration of the urine been employed, as so clearly indicated, instead of resorting to anæsthesia, for a futile purpose, there would not have been a rupture of the bladder. The fate of this man naturally suggests that no patient whose bladder is much distended should be subjected to anæsthesia until the viscus is relieved of its burden of urine.

25. Rupture, incomplete or complete, single, double, or multiple, may occur in any of the divisions of the bladder. It may involve the peritonæum or any of those adjacent parts that are not invested by this serous membrane. It occasionally occurs while the organ is in a state of vacuity, but in the vast majority of instances the accident has happened while the viscus was distended with urine. It has been suggested that rupture of the bladder may have for predisposing cause some morbid condition of the organ rendering it vulnerable or lessening the resistance of its wall to a shock or blow or to straining when it is in a state of plenitude. If it be remembered that the rending of the vesical wall occurs ordinarily in men under the age of fifty, when the bladder presumably is sound, this notion will be tenable only within very restricted limits. The diseased bladder has been ruptured by its simple distension with urine or when artificially distended as in the instance related by Wyeth, who, during treatment of a case of chronic cystitis, threw in fourteen ounces of fluid which caused a rent through the anterior vesical wall.* From traumatisms proper should be distinguished those solutions of continuity caused by calculi or foreign bodies that have lingered indefinitely in the bladder, or the leakage of urine which results from perforative ulceration at the bottom of certain small pouches so often found in the bladders of men who have long suffered from urethral or prostatic obstruction to urination, as pointed out by Mercier in his paper on spontaneous perforations of the bladder.†

* New York Medical Journal, October 19, 1901.

† See Bladder Sacculation. Note 14.

26. A few typical instances of ulcerative perforation by a stone or by a catheter should here be noted for the reason that the condition has been confounded so often with rupture of the bladder. The first case related by Horwitz * is an excellent example, not of vesical rupture but of intra-peritoneal ulcerative perforation of the bladder wall by a large stone, as appear to be the twenty-nine additional cases to which he refers. His second case is another good example of perforation caused in this instance, by the retention of a metallic catheter. A man of middle age, under treatment, at Bellevue Hospital, for urethral stricture, was put to bed and an ordinary stiff gum catheter introduced and retained in the bladder for continuous dilatation of the stricture. At the end of two days the instrument was withdrawn, when he suddenly collapsed and died during the night following. The necropsy showed, at the lower part of the posterior wall of the bladder, an intra-peritoneal ulcerative perforation through which a flood of urine had escaped. A similar case is mentioned by Spence, of Edinburgh.† None of these cases could properly be placed in the category of bladder rupture.

27. Of incomplete rupture, Smith gives in evidence but one case, originally reported by Keal, in which the rent did not extend entirely through the bladder. The injury occurred while the patient was straining to urinate. He "felt something crack in his abdomen," then had a chill. His bladder was relieved of "two quarts of bloody urine" by means of a catheter, and he recovered.

* Annals of Surgery, December, 1905.

† See note 33—Ureth. strict. in the perineal region; their external division.

28. Complete rupture occurred in seventy-seven of the seventy-eight cases to which reference has been made. Forty-eight of these involved the peritonæum; eight were at the anterior surface below the peritoneal reflection; three were on the right side; two on the left side; and five were at or near the neck. In the remaining cases the site of the rupture is not clearly stated. In sixty-nine cases the rupture was single; in four cases there were two rents; in one case there were three rents; in one case there were many rents, the number not stated; in one case no bladder was found; and in one case the whole viscus was destroyed except the trigone. Twenty-three of these patients were in a state of alcoholic intoxication at the time of the injury.

29. The very high percentage of mortality from rupture of the bladder prior to 1851, and even down to 1882, its immediate and remote causes, and the lesions consecutive to the injury, though already pointed out are again briefly referred to if only as a reminder that, in the majority of instances, the vesical injury is within reach of an exploring supra-pubic incision which admits of no delay, otherwise it would not be possible to avert peritonitis or destructive urinary infiltration of the pelvic connective tissue and consequent sepsis.

30. The lesson taught by the mortuary records of former times is of much practical import, especially in consideration of the means now employed in the diagnosis and treatment of bladder rupture, for the errors of laborers of the past, when carefully scrutinised, cannot fail to enlighten those of the present. Even when the diagnosis is not made early, there is a fair hope of rescuing some victims after the lapse of many days from

the time of injury, and it may be safely said that it is scarcely ever too late for the surgeon's ministration, with knife in hand, though he may expect nothing more than the mitigation of suffering.

31. The foregoing notes, sufficiently indicating the causes and immediate effects of, as well as the former percentage of mortality from, rupture of the bladder, may properly be followed by annotations on its main symptoms, its diagnosis, and its modern treatment.

32. The symptoms of this injury vary according to the degree of violence inflicted upon the organ and adjacent parts; for instance, a fall from a great height, a powerful concussion, the crushing of the pelvis under the wheel of a heavy wagon, a very severe blow to the hypogastrium, etc., followed, perhaps, by the passage of a little bloody urine, may at once indicate the true nature of the hurt, or may cause such profound general shock as, at first, to mislead the observer. But when, soon after any such injury, there is a constant desire and inability to urinate, this symptom is surely significant of vesical rupture, particularly if, to relieve this supposed ischuria, a catheter is introduced and little or no urine flows; anuria being of course excluded. If during straining efforts retention of urine is suddenly apparently relieved, the presumption is that the bladder wall has given way and that through the rent the urine is poured into the peritoneal cavity or the pelvic connective tissue, especially if this apparent relief is preceded by an internal explosive sensation, and followed by a sharp pain in the hypogastric region and rapid abdominal distension in case the rupture involve the peritonæum. Then follow nausea, vomiting, syncope, lowering of the

body-temperature, undue frequency of the pulse, unquenchable thirst, etc. Some of these symptoms are often wanting, and occasionally patients make no complaint whatever, are able to walk about, and yet die of the injury within a few days or even a few hours. Those surviving beyond three or four days are generally attacked with violent peritonitis which leaves no doubt as to the site of the rupture, or are seized with rigors indicating urinary infiltration of the pelvic connective tissue. Sudden collapse following a severe blow to the hypogastrium or violent straining to relieve an overdistended bladder is suggestive of a large rent through which an abundance of urine is poured into the peritoneal cavity or into the pelvic connective tissue. In case of a small rent there are, at first, but few if any indications of its occurrence beyond the sensation of "something cracking" in the abdomen. However, the constant desire and inability to urinate seem to be present in nearly all cases. Later, when there is a diffuse swelling and crepitation in the lower hypogastrium, a rent in the anterior vesical wall has probably occurred, whilst the same condition discerned in the ischio-rectal region is a fair indication of rupture of the lower lateral wall or of the neck, with infiltration of the pelvic connective tissue. Such are among the most prominent symptoms of bladder rupture.

33. The diagnosis of rupture of the bladder would ordinarily be easy if the symptoms detailed in the preceding note were always appreciable, but they are too often masked by the immediate effects of certain injuries of other parts or, at times, are extremely obscure and even altogether wanting. Therefore it is that the

diagnostician should give the most careful consideration to such phenomena, be they never so slight, as may be manifested; but if still in doubt he should not waste time in striving to assure himself of the true nature of the injury and at once proceed to an exploratory operation to be followed perhaps by a radical process of cure. The only safe preparatory exploratian to be made is by means of a soft catheter partly to help in excluding anuria, especially in the case of a drunken man. The water test has proved so harmful that few surgeons now use it; the bad effects of the air test have led to its rejection; and resort to the cystoscope, for ascertaining the site of the rupture, generally consumes too much of the precious time that should be otherwise employed for the good of the sufferer.

34. The treatment of vesical rupture, always to be undertaken without delay, varies in accordance with the site of the rent, but in case of any doubt, a supra-pubic explorative incision should at once be made to bring into view the bladder, since the great majorities of its wounds are accessible by this route. A prompt exploration of this sort would probably have saved the life of the man who survived for forty-six days a rupture involving the pelvic connective tissue, and whose case is related in note 23 of this chapter. The two following examples of the good effects of a free supra-pubic incision are of sufficient interest to be again recorded. They both recovered. In July, 1848, Professor Syme was called to see a youth of seventeen, who, in attempting to leap a fence, had fallen forward, striking violently his abdomen against a spar, and ruptured his bladder. Four ounces of bloody urine were drawn off through a catheter

which was again used on the next day with the same effect. On the third day a free supra-pubic incision was made which gave issue to a quantity of urine. A finger passed into the wound entered the bladder. Sloughs of connective tissue came away on the seventh day, and two weeks after the operation the patient was well. In the New York Medical Times for January, 1855, A. V. Williams gave an account of a case of rupture of the anterior vesical wall, of which the following is a brief abstract: On June 10, 1854, Dr. Williams was requested to see a man thirty-two years of age suffering from a very narrow urethral stricture with tw days retention of urine, during which, while making a violent effort to expel urine, "he felt something give way with a snap in his belly," to the apparent relief of the ischuria. On the next day a supra-pubic incision was made through which urine flowed abundantly. The bladder was then cut open in the median line with a view to extroduction of the catheter. Urine continued to pass away through the wound, and sloughs of connective tissue having been cast off, left a granulating surface which speedily healed, and on the twenty-seventh day the wound had entirely closed.

35. The perineal route, except in the case of urethral stricture as the remote cause of the rupture, does not seem to be equal to the supra-pubic route, although the lower cut has answered well on sundry occasions. Two notable instances may be mentioned; the first recorded by Walker, of Massachusetts, in 1845, and the second by Mason, of New York, in 1872. (1) A man twenty-three years of age, injured by rail cars while his bladder was distended, suffered a fracture of the pelvic bones and

rupture of the anterior vesical wall with urinary extravasation in the right iliac region, to relieve which Dr. Walker resorted to a lateral perineal incision extending into the bladder as in the operation for stone. This prompt measure afforded free escape for the extravasated urine and served also to drain the bladder until the parts healed. The patient made a good and rapid recovery. (2) This method of treatment was tested by Dr. Mason, who, in a case of bladder rupture with urinary infiltration of the pelvic connective tissue, made the perineal cut forty hours after the injury, and the patient was well on the thirty-ninth day. In any case of vesical rupture, with urethral stricture as its remote cause, the perineal route has the advantage of relieving the stricture whilst it drains the bladder and adjacent infiltrated connective tissue. In such a case a median perineal incision is made through the stricture and the whole membranous region of the urethra, then a prostato-vesical cut as in medio-lateral lithotomy. But when, through rectal digital exploration, there is reason to believe that the rupture has occurred at or near the vesical neck, the lateral perineal cut is clearly indicated as the most direct means of draining the infiltrated connective tissue.

36. In case of intra-peritoneal rupture, divers plans of treatment were, at first, proposed, among which was that of Harrison, of Dublin, who suggested, but never carried out, the tapping of the peritoneum through its recto-vesical pouch. This proposal was made on account of the invariable failure of abdominal tapping with intent to rid the peritoneal cavity of the effused urine. Thorp succeeded in passing a catheter by the natural

route and so through the intra-peritoneal rent of a ruptured bladder; drawing off the effused urine and washing the peritoneal cavity with warm water. The patient recovered.* This process, now quite unnecessary, has since been employed by other surgeons. However, in none of these instances was any attempt made to close the vesical wound. The first proposal to that effect was from Dr. Blundell, who said substantially that, in cases of bladder rupture involving the peritoneum, he would recommend the making of a supra-pubic incision, draw off the effused urine, wash the peritoneal cavity with warm, distilled water, and close the laceration with a ligature, etc. This method of treatment, then regarded as too heroic and unwarrantable, is the one now carried out so successfully with the technic modifications that have since been made.

37. The steps of the present mode of effecting closure of intra-peritoneal bladder wounds are as follows: The patient is placed in the Trendelenburg position; a sufficient incision is made in the median line to freely expose the bladder; and, after thoroughly cleansing the peritoneal cavity, the intestines are held back by a wad of gauze. The sutures, either of fine silk or chromicised cat gut, are applied by means of a curved instrument similar to the needle used in uranoplasty. Two rows of interrupted Lembert stitches are needed. In the first row, the sutures, about five millimeters apart, should be through the fibrous and muscular layers, and in the second row through the peritoneal coat, or in this second row the mattress suture may be used. The first and

* Observations on Rupture of the Urinary Bladder, by Henry Thorp, M.D., Dublin Quarterly, 1868.

last sutures of either row should be applied very close to the angles of the rent as a precaution against leakage of urine. When the rupture is at or near the summit of the bladder, its closure is attended with comparatively little difficulty, but when low down on the posterior wall, the suturing is a very delicate, slow, and tedious process requiring much patience, skill, and gentleness. However, despite the observance of the greatest precautions in closing the rent, slight leakage of urine has sometimes occurred, but, as a general rule, this has not proved very serious. It is only an abundant flow of urine causing general peritonitis that endangers life. It is not wise to distend the bladder by means of water or air with intent to demonstrate the impermeability of the closed rent, because such distension is almost certain to weaken if not to more seriously injure some part of the line of sutures and so cause fatal leakage of urine within two or three days. Neither is it wise, after closure of the external wound, to retain a catheter in position for drainage of the bladder as the clogging of the instrument is more than likely to cause a retention of urine sufficient to reopen the closed rent. The urine should therefore be drawn off every two hours at first, later every three hours, if there be not polyuria, and this frequent catheterism should be continued during eight or ten days from the time the external wound has been stitched and suitably dressed.

38. In a paper on *Traumatic* Intra-peritoneal Rupture of the Bladder (Am. Med. Journal of the Medical Sciences, July, 1906), Ashhurst analysed one hundred and ten such cases, of which sixty-three recovered and forty-seven died. These one hundred and ten cases of

bladder rupture had occurred between the years 1860 and 1905 and had been subjected to operation from less than eight hours to the third day after the injury.

39. There is a feature in intra-peritoneal rupture of the greatly over-distended bladder which has a very important diagnostic and therapic significance, and that is the profuse hæmorrhage which sometimes occurs, not from the rent but from the whole surface of the vesical mucous membrane; this excessive bleeding being due to the sudden cessation of the mechanical pressure exerted upon the capillaries of the membrane * by the cushion of urine. This sort of hæmorrhage appears to have occurred in the case cited in note 24 of this chapter, and also in six of Smith's cases in which a very considerable amount of blood, much more than could be accounted for by the mere laceration, was found in the peritoneal cavity. In such circumstances, before attempting to close the vesical wound, it is well to look for blood-clots in the bladder and at once extract them, if necessary, through a cut made in the anterior wall, and then to use means for the speedy staunching of the hæmorrhage if not already arrested by the natural contraction of the muscular coat; otherwise the bladder is likely to become greatly distended with blood and so destroy the work of repair of the rent and perhaps end the sufferer's life. Profuse hæmorrhage occurring in case of any rupture which involves the pelvic connective tissue, requires a treatment similar to that employed to check the bleeding that follows the precipitate evacuation of the over-distended bladder, and which is detailed in the chapter on bladder hæmorrhage.

* See note 2, chapter XXIII, Bladder Hæmorrhage.

XVIII

FOREIGN BODIES IN THE BLADDER

1. The surgeon is not unfrequently called to extract foreign substances that have reached the cavity of the urinary bladder from within or from without the human body. It therefore behooves him to be on the alert respecting the divers routes taken by these intruders, some of which pass into this viscus from the intestinal canal, whilst others enter through external wounds or by way of the urethra.

2. Ingesta, from the small or from the large intestines, such as seeds, vegetable fibers, or cells, fish or bird bones, etc., often pass into the bladder, by an ulcerative process, to form nuclei of stones. Needles, pins, and other small solid substances accidentally swallowed, have been propelled, without accident, through the greater part of the intestinal canal until finally arrested near enough to the bladder to pierce both intestine and bladder and so drop therein and remain undiscovered until found in the center of extracted calculi. Fragments of fractured or necrosed pelvic bones have also found entrance into the bladder to be soon encrusted with urinary salts. Even entozoa have migrated into the bladder.

3. The more commonly encountered vesical foreign bodies are those which gain entrance by way of the

urethra. Amongst them are fragments of metallic instruments and of elastic catheters or bougies, entire catheters or bougies, glass tubes, lead pencils, shoe-strings, leather thongs, straws, rushes, beans, sealing wax, cylindric bone implements, pipe-stems, and a great host of other objects too many to catalogue.

4. Foreign bodies have been thrust into the bladder from the rectum through accidental or designed impalement; and shot wounds of the pelvis and of the soft parts in the hypogastric or inguinal regions have carried into this organ bullets, fragments of bone, splinters of wood, bits of clothing, etc. These and all other extraneous substances lingering in the vesical cavity soon become the nuclei of stones.

5. The introduction of lithotrity seems to have led to a much closer inquiry than ever before made into the nature of the nuclei of bladder-stones, and this inquiry resulted in the discovery of a greater proportion of extraneous nuclei than was supposed; hence the practice of early diagnosis and prompt extraction of vesical foreign bodies as preventive of their calculous incrustation. Civiale was of course prominent in this important investigation and soon collected and analysed one hundred and sixty-six cases of stones which had been formed around alien substances in the bladders of males and females, with the following results: Of these one hundred and sixty-six cases, the nuclei were pins and needles in thirty-two cases; bougies and catheters in twenty-one cases; pieces of wood in fourteen cases; bullets in thirteen cases; fragments of bones, pipe-stems, barometer tubes, and stems of plants, in twenty-four cases; beards of barley and hairs in fourteen cases;

pledgets of lint in four cases; and rings, nails, fruit pits, needle cases, etc., in forty-four cases.

6. Of foreign substances entering the bladder from within the body, examples are not lacking, but a few only need be given. Two such cases occurred in the writer's practice. One patient suffering from a large vesical stone and subjected to lithotrity, had passed, for some time, urine containing vegetable cells and other ingesta, all of which disappeared soon after the bladder had been relieved of its calculous burden, the nucleus of which was fecal matter. A second similar case, requiring perineal lithotrity, was likewise cured and the patient no longer passed feculent matter by the urinary conduit. The exact site of the fecal fistula could not be determined in either case. Another instance of a foreign body passing into the bladder by an ulcerative process and forming the nucleus of a stone may be worth noting. The patient was subjected to epicystotomy by the writer, who found the nucleus of the concretion to be a bit of necrosed bone, probably from the ischium. A case is recorded by Dr. Eve, in which he removed from the bladder a portion of fractured bone, probably of the pubis or ischium, surrounded by a calculous mass.

7. Certain vesical foreign bodies are sometimes expelled spontaneously, particularly in cases of capacious urethræ. Thus fragments of catheters, pistol bullets, and other small objects have passed from the bladder into the urethra to be carried away by the urinary current.

8. The many different extraneous objects passing into the bladder from without the body may be arranged into two distinct groups; first, those entering through

external wounds or through rectal puncture by impalement, and second, those entering by way of the urethra.

9. Examples of foreign bodies that reach the bladder through external wounds are to be sought chiefly in works on military surgery and include musket and rifle balls, fragments of shells, splinters, bits of clothing, etc., which, in general, were discovered only after the consequent vesical irritation was clearly manifested, or after the required cystotomy had revealed a stone having for its nucleus one of these extraneous objects. The case cited in note 12 of the preceding chapter is a fair illustration of a foreign body which passed into the bladder by way of the rectum through accidental impalement.

10. The foreign bodies entering the bladder by way of the urethra are those of ovoid, elliptic, or cylindric form. A commonly cited case was that of a drunken man, into whose urethra a companion had forced a great quantity of beans, some of which had reached the bladder. A case of vesical foreign body, remarkable in its moral, physical and surgical aspects, occurred in Granville, Vermont, in the practice of Dr. Pond, who communicated the facts to Professor Parker, of New York,* is here given in abstract as follows: A married man, fifty years of age, illiterate, boorish, depraved in the extreme, and an inveterate masturbator, who, to gratify his lust, used extraordinary means, such as inflation of his urethra and bladder and divers other modes of exciting his genitals. He once introduced into the urethra a bull's penis which had to be extracted by the physician. Finally he prepared a rod of lead, ten inches

* New York Journal of Medicine, 1852. The case is also recorded in "Eve's Remarkable Cases in Surgery."

in length, three-fourths of an inch in diameter, and seventeen ounces in weight, which he introduced into the urethra and which slipped into the bladder. Although the foreign body caused much vesical irritation for several days, he indulged in a drunken debauch and was taken home from the tavern in a jolting lumber wagon. On the following day he was seized with violent dysuria, during which "the bladder ruptured." To assure himself of the fact, he blew through a tube passed into the urethra and felt the air gurgling in the abdominal cavity. The abdomen was laid open and the leaden rod, found in the peritoneal cavity, was removed. The patient died on the fifth day after the operation and the fourteenth day from the introduction of the rod. The reporter acknowledged that "the rupture was, probably, rather a puncture of the bladder resulting from the constrained position of this metallic bougie."

11. Glass tubes, as already noted, are among the objects that have formed the nuclei of vesical stones. Such instances are reported from time to time. To increase the number of recorded cases, the writer will mention the only one treated by him: In extracting the fragments made by the lithoclast during perineal lithotrity, in a man of middle age, he found, amidst those fragments, bits of glass which proved to be parts of a thermometer tube that had lingered in the bladder for several months.

12. Amongst the other queer sorts of foreign substances he has found in the bladders of men was a cylindricly fashioned piece of raw potato, about nine millimeters in diameter and ten centimeters in length, introduced by the patient into the urethra and swallowed by

the bladder. Twenty-four hours after the accident, extraction of that body in its entirety was effected in two minutes by means of a rectangular metallic instrument with forceps extremity, seizing the object at one of its extremities. On many occasions the writer has been called to extract, from the urethra and bladder, fragments of web and India-rubber catheters, as well as entire catheters and bougies, and has generally been able to do so with the simplest tools.

13. The realisation of the importance of speedily removing extraneous objects from the vesical cavity by such means as cause the least injury to the parts, led surgeons of the early part of the nineteenth century to employ lithtriptic and other instruments for the extraction of oval and oblong foreign bodies without recourse to the knife. The results of some of these early operations are herein given in illustration of the wise conservatism which met with such general approval. In the year 1835, Tyrrell, of London, withdrew from the bladder a fragment of metallic catheter, through the urethra, by the aid of one of Weiss' tools designed for the purpose. Civiale had soon brought into play his trilabe to remove a piece of bougie that had been in the bladder long enough to be incrusted. Ségalas, in 1837, extracted, with a lithotriptic instrument, an incrusted fragment of elastic bougie after having broken the crust. Dillon, of Pittsburg, Pa., in 1850, employed Heurteloup's lithotrite to remove a fragment of elastic catheter from the bladder of an elderly man. And, in 1853, Maisonneuve, with an ordinary lithotrite, extracted a common bean without even bruising it. Cutting operations for the removal of cylindric foreign

bodies from the bladder were soon regarded as inexpedient devices of the past. Nevertheless there are still some surgeons who advocate the use of the knife in such cases.

14. Exploration for the detection of a vesical foreign body is made with a metallic instrument suitable at the same time for its extraction, provided this body be cylindric, elliptic or ovoid. Experience has taught that either for exploration or extraction of a foreign body, as a general rule, artificial distension of the bladder is not desirable.

15. The principal instruments at present in use for extracting oblong foreign bodies, besides small lithotrites, are the one described by Mercier, and those made for Nélatan by Matthieu and by Charriére.

XIX

BLADDER TUMORS

1. New growths in the urinary bladder may be benign or malignant, primary or secondary; that is to say, may be developed independently of growths in distant parts of the body or may extend from neighboring growths. Benign vesical neoplasms of long standing are sometimes transformed into the malignant type. These divers tumors have been found in all the regions of the bladder. The benign growths are those which are the more common. These are the inomata which are generally papillary and styled papillomata. However, some of the epitheliomata are papillary and bleed. The sarcomata are malignant as are the rhabdomyomata. The leiomyomata are of rare occurrence and are benign as are the simple angeiomata. Such are the views of the best writers on this subject.

2. The writer has had but little experience in the management of bladder tumors; having seen only fourteen cases of which three were primary carcinomata, one secondary carcinoma, one primary sarcoma, and nine benign papillary inomata.

3. Of the three cases of primary carcinomata the diagnosis was made in one. In the two other cases the nature of the disease was not ascertained until after death, as was that of the secondary carcinoma which was consecutive to a malignant rectal growth. The case

of primary sarcoma was diagnosticated some time before death; the unfavorable prognosis, which was soon verified, having been declared after a microscopic study of bits of the tumor expelled with the urine during examination of the patient. No post-mortem inspection was permitted.

4. The first example of papillary inoma was discovered in the bladder of an elderly man who had had very copious vesical hæmorrhages and who had died in consequence. The post-mortem examination revealed two papillary inomata of about a centimeter at their base. One of these growths was close to the left ureteric orifice and the other higher up and on the posterior vesical wall. The second example was that of a middle-aged man brought to Bellevue Hospital in a moribund condition due to profuse vesical hæmorrhages and who died in the course of three days after his admission. The diagnosis of papillary inoma was made by the passage through the whole length of the urethral canal of a rectangular bladder forceps with jaws like those of a lithotrite, and the seizure of a bit of the growth which was pinched off, extracted, subjected to microscopic inspection, and found to consist chiefly of looped vessels. The necropsy revealed three papillary growths in the bladder; one on the left side and two in the posterior wall.

5. The third and fourth cases were diagnosticated as was the case just related. The third was that of a man forty-five years of age, who for eight years, had suffered from intermittent hæmorrhages increasing in amount from year to year until he applied to the writer for treatment during the autumn of 1879. The growths were

removed, through a median perineal incision, with the forceps recommended by Sir Henry Thompson. The patient survived the operation but three weeks. In the case of the fourth patient, who had long suffered from intermittent bladder hæmorrhages, the same mode of diagnosis and treatment had a like ending to the third case, only the man died three days after the operation. In both cases the growths were large and multiple.

6. The fifth case was that of a man twenty-five years old who had suffered for several months from intermittent vesical hæmorrhages. There was evidently but one small growth in the bladder, for no hæmorrhage occurred after the tumor was pinched off with the bladder forceps. He made a rapid recovery, and there was no recurrence of the disease. The sixth and seventh cases were of the same sort as the fifth, and were similarly diagnosticated and treated with the same happy result. The mode of diagnosis employed in these cases has often served as radical treatment, in the practise of divers surgeons, when the growth has happened to be very small.

7. In the eighth case the diagnosis was easily made and the growth was removed through a supra-pubic cystotomy. This patient also made a good and prompt recovery.

8. The ninth case presented a feature which, during the operation, was at first perplexing although a bit of the tumor had been pinched off with the bladder forceps and had shown looped vessels under a low power of the microscope. The patient had bled profusely and intermittently from the bladder for more than a year. Supra-

pubic cystotomy was done with a Pacquelin platinum blade heated to the red heat. When the bladder was fairly opened, no growth from its mucous membrane was detected. But it was soon ascertained that the heated blade had passed through a small villous tumor seated at the lower part of the anterior vesical wall exactly in the median line and so had destroyed the growth. The patient, who made a good recovery, was heard from five years after the operation and was entirely free from vesical trouble.

9. It was the unfavorable result in the two cases operated upon after the method of Thompson that led the writer to advocate the supra-pubic route as the more certain and safe operative measure in such cases. It is by this route that papillary growths are so successfully removed by prudent surgeons.

10. For the diagnosis of papillary growths, the cystoscope would always answer well if it were not for the frequent obscuration of the field by the oozing blood from the tumor. Therefore, exploration with the rectangular bladder forceps and microscopic inspection of the pinched off bit of tissue will probably continue to be the crucial test of the cause of the hæmorrhage and of the nature of the neoplasm.

11. For valuable information on the nature and treatment of bladder tumors, the reader is referred to Dr. Albarran's masterly work,* wherein are depicted all known forms of neoplasms, with a great abundance of admirable illustrations, and wherein are ably discussed the questions of cystectomy and the disposal of the ureters. A recent contribution to this branch of sur-

* *Les tumeurs de la vessie.* Par J. Albarran. Paris, 1891.

gery is from the pen of Dr. Watson,* with the following sub-title: "A proposal to substitute bilateral lumbar nephrostomy and the establishment of renal fistulæ in cases of bladder tumor, for ureteral implantation in connection with bladder resection or total extirpation, and that the bladder operation be done after an interval and not together with the nephrostomies.

* The operative treatment of tumors of the bladder. By Francis S. Watson, M. D., Boston. Annals of Surgery, December, 1905.

XX

URO-CYSTITIS; ITS NATURE, CAUSES AND EFFECTS*

1. Inflammation of the urinary bladder occurs with great frequency from early childhood to extreme old age. In the first case it is generally owing to the presence of a calculous or of a foreign body; in the second case to obstructed urination or some other source or local irritation. The inflammatory process is ordinarily confined to the mucous membrane, but it often invades secondarily the sub-mucous and muscular coats and, in rare instances, the outer fibrous and peritoneal coats. The word cystitis was formerly limited to the designation of an inflammation implicating all the coats of the bladder. Then when found to be confined chiefly to the mucous coat, it was termed catarrhal fluxion or catarrh of the bladder. Finally the awkward term "catarrhal cystitis" was thrust into the language of medicine, with the arbitrary signification of inflammation of the mucous membrane supposed to yield an abundant flux of mucus, whereas this imaginary mucus is, in reality, the slime of alkaline stagnant purulent urine.

2. The causes of this inflammation may be placed in four categories as follows: (*a*) cystitis due to deviations in the quantity or quality of the urine; (*b*) cystitis due to the extension of inflammatory action of neighboring

* Reproduced, with alterations and additions, from Lecture V in "*Diseases of the Urinary Apparatus.*"

parts or organs; (*c*) cystitis due to injuries, or to other local irritants; (*d*) cystitis due to the stagnation and fermentation of the urine.

3. *a*. Any marked deviation from the normal standard of quantity or quality of the urine is apt to cause cystitis. When, from disturbed innervation or from structural disease of the kidneys, urine of low specific gravity rapidly and constantly distends the bladder, the mucous membrane of this organ becomes waterlogged, the superficial epithelial stratum is cast off and the irritating urine induces in the underlying capillaries a sufficient degree of congestion to permit the emigration of great numbers of leucocytes which, on reaching the surface, soon die and become pus. If the urine from such a bladder be subjected to microscopic inspection during the early days of persistent polyuria, it will be observed to contain numberless swollen epithelial cells which have been washed away from their bed by the great flood of pale urine. Examined later, it is found that these epithelial cells are much exceeded in numbers by pus corpuscles, and that the urine contains also some red blood-cells. In cases where the reverse condition exists, that is to say when the urine is inordinately decreased in quantity and its specific gravity much increased from excess of solid matter, chiefly uric acid, this acrid urine acts as a powerful irritant to the mucous membrane and causes cystitis. Certain poisons induce oliguria when taken even in moderate doses for a long time, notably opium. To what extent those who use this drug habitually and excessively suffer from vesical irritability is worthy of special inquiry on the part of the physicians who have charge of such persons.

4. Congestion of the vesical mucous membrane from any cause renders this membrane vulnerable even by normal urine. One of the causes of vesical congestion deserving more consideration than it generally receives is disturbance of the cutaneous circulation. This disturbance arises from several different diseases, and also from certain injuries of the skin.

5. Paludal fevers with frequently recurring rigors, and the so-called congestive fever, are attended with oligæmia of the body surface and consequent congestion of the internal organs and of the mucous membranes. At first, the kidneys secrete scantily and the urine, overcharged with solid matter, irritates the congested bladder and causes very frequent urination. Later the secretion greatly increases in quantity and washes away much of the bladder epithelium. The urine soon becomes turbid from the presence of pus and saline matter. There is then a sub-acute general myxo-cystitis which, however, ceases soon after the removal of the original cause.

6. Any extensive laceration or ablation of the cutaneous surface causes shock, rigors, and internal congestion. The urine, at first scanty, soon increases in quantity and constitutes the irritant exciting cause of the cystitis. Extensive burns of the skin also constitute an indirect cause of cystitis. From the examination of statements made by Dupuytren, Nélaton, Legouest, and other surgeons, and from the observation of cases in Bellevue Hospital, it seems that extensive burns of the surface of the body have often been the indirect cause of cystitis. But to ascertain the proportion of cases of cystitis caused by burns would require very extended investigation. Theoretical reasons, clinical ob-

servation, and necropsic evidence have been furnished by careful investigators, from the time of Dupuytren, to explain the mechanism of the cystitis thus indirectly caused. The earliest phenomena noted of extensive burns of the body, irrespective of degree, are shock, rigors followed by febrile reaction, inordinate thirst, frequent desire to urinate, and congestion of the mucous membranes. These phenomena, and especially the congestion, are accounted for partly by the sudden disturbance of the nervous system and of the cutaneous circulation. Granting the occurrence of congestion of the vesical mucous membrane, then normal urine, even in small quantity, is sufficiently irritating to this congested membrane to cause frequent and urgent urination, and later, cystitis. Impairment of the function of the great glandular apparatus, the skin, such as results from extensive burns, is apt, in a short time, to impose much additional work of elimination upon the kidneys, and the resulting polyuria aggravates the beginning cystitis induced by the first irritant which may have been a urine diminished in quantity but surcharged with solid matter, or even normal urine in quality and quantity..

7. Exposure to humid cold is spoken of by many authors as a cause of cystitis, doubtless with clinical foundation, but generally with no explanation as to how and why humid cold produces this effect upon the bladder. Exposure to humid cold is sometimes the indirect cause of cystitis because, like paludal and "congestive fevers," it causes primarily some disturbance in the cutaneous circulation leading to congestion of the vesical mucous membrane and rendering it vulnerable by the urine which is the excitant of the cystitis.

8. Deviations in quality of the urinary secretion now require some notice. Persistent hyperlithuria, so common among dyspeptics, is a frequent cause of cystitis. Highly acid urine, whether increased or decreased in quantity, but containing an excess of uric acid, mechanically irritates the bladder and excites inflammation to a greater or lesser extent of its mucous membrane, beginning generally at or near the urethro-vesical orifice which is pricked at each act of urination by the almost innumerable sharp-pointed crystals. Some of the most distressing cases of cystitis begin in this way. Persistent oxaluria, by the same mechanism, causes trachelo-cystitis. Alkaline urine, as will be seen later, likewise causes cystitis.

9. Pyuria from chronic pyelitis also gives rise to cystitis of the lower fundus, partly from fermentation and the irritating action of the ammonium carbonate evolved from the fermentative process.

10. Glycosuria is another cause of cystitis which is often overlooked. In cases of excessive glycosuria, with or without polyuria, saccharine fermentation is liable to occur and cause very distressing cystitis.

11. Cantharidine, taken internally or absorbed by the skin from Spanish-fly blisters and eliminated by the kidneys, is a powerful irritant, of the vesical mucous membrane and causes trachelo-cystitis with very painful strangury. The French, who sometimes use the resin of thapsia as a counter-irritant think that its absorption and elimination produce effects similar to those of cantharidine.

12. Turpentine causes cystitis either when taken internally in poisonous doses, or through gradual satura-

tion of the system by inhalation of its fumes, as occurs among workmen in varnish factories or among sailors on "turpentine ships"; some of the men being attacked with nephritis, trachelo-cystitis, and even urethritis, attended occasionally with profuse hæmaturia.

13. Excesses in alcohol, new beer, and cider drinking are often potent factors in the causation of cystitis.

14. Ether, when inhaled during one or two hours for anæsthetic purposes, being largely eliminated by the kidneys, induces at first oliguria, then polyuria. In cases of prolonged anæsthesia, perfect consciousness is not ordinarily restored for three or four hours after cessation of the ether inhalation. Sensation remains blunted and the mind somewhat cloudy for some time after this, so that any discomfort caused by urinary accumulation in the bladder is vaguely attributed either to the region of the late operation or to some distant part of the body. Unless particular inquiry or an examination is made, the bladder becomes so over-distended in the course of twelve hours that the patient cannot urinate at will. This over-distension, together with the congestion induced by the irritant ether with which the urine is charged, causes a cystitis which often persists many weeks and sometimes becomes chronic. This cystitis is not an uncommon accident of many surgical operations necessitating prolonged anæsthesia.

15. Careful inquiry into all possible aetical factors serves to eliminate cases of so-called spontaneous or idiopathic cystitis.

16. *b.* Cystitis due to the extension of inflammation from neighboring organs is not unfrequent, and occurs at the vesical neck as a consequence of urethritis on or

about the third week of the beginning of the urethral inflammation. Although in the majority of cases this trachœlo-cystitis seems to come without provocation, it is often excited, during urethritis, by coitus, alcoholic excess, irritating injections, or catheterism. It is sometimes excited also by gonecystitis, prostatitis, hæmorrhoids, proctitis, etc.

17. *c.* Of cystitis due to injuries and other local irritants, the causative agents are of many different sorts. Unduly frequent catheterism doing violence to the epithelium at the vesico-urethral orifice thus causes subacute or even acute trachelo-cystitis, and is liable to cause general myxo-cystitis, especially when unclean instruments are used. Violent catheterism by contusing or tearing the neck or body of the bladder, causes cystitis. Contusions or wounds of the bladder directly cause cystitis, and also indirectly by leaving behind some foreign body as the irritant, such as a clot of blood, a bullet, a scale of bone, or a piece of the wounded person's clothing.

18. Among the irritants known to cause cystitis are calculi, foreign bodies, entozoa, new growths, and tuberculosis. No comments need be made at present upon these causative agents, except in the case of entrance into the bladder of some of the foreign substances that reach it from the small and large intestines and from without. Knuckles of small intestines sometimes become adherent to the peritoneal coat of the bladder, and by ulceration, allow the intrusion of divers substances besides a part of their contents into the vesical cavity. Thus needles, pins, fish-bones, seeds, and other objects pass from the intestines into the bladder to give rise

to cystitis. In a dissecting room specimen it was discovered that three knuckles of the ileum had become firmly adherent to the upper part of the bladder, and that between each of these knuckles and the bladder there was an opening, nearly circular, with smooth edges, and about twelve millimeters in diameter. Judging from the appearance of the parts, the ulcerations had probably occurred several months before death. It was also evident that the existing cystitis was caused by the constant passage of intestinal contents into the bladder. In a case of iliac abscess from perforation of the appendix vermiformis, occurring in a boy, the tumefaction suddenly subsided, and the patient's urine was found to contain fæcal matter. The consequent cystitis did not last very long, and the boy made a good recovery. There are many cases on record where fæces and other foreign bodies had passed from the rectum into the bladder to cause cystitis and become the nuclei of phosphatic stones. The prolonged retention of catheters for drainage of the bladder, broken ends of catheters, and other foreign bodies introduced from without are among the many factors in the causation of cystitis.

19. *d.* Cystitis due to stagnation and fermentation of urine from obstructed urination claims its share of the attention given to the question of causation so important in its relations to diagnosis, prognosis, and treatment. The first effect of obstructed urination, whether from urethral stenosis, prostatic enlargement, or urethro-vesical contracture, is a series of spasmodic contractions of the bladder which is thus incessantly wrestling with the obstacle to expulsion of the urine. If this be not artificially relieved, the struggle continues week

after week, and month after month. During that time the stream of urine steadily diminishes in size and force, and the bladder does not completely empty itself. The stagnant urine soon undergoes fermentation followed by the evolution of ammonium carbonate which is a potent factor in the production of the cystitis.

20. Some diseases and injuries of the brain or spinal cord are followed by retention of urine, often said to be due to paralysis of the bladder. If complete paralysis of the bladder occurs, it seems as though there should be incontinence and not retention of urine. In cases of disease or injury of the nervous centers, is not the retention of urine due to impaired sensation in the bladder which then allows the urine to accumulate and distend it; the disease or injury of these nervous centers interfering with the reception of the impression of the need to urinate? Carefully observed cases seem to indicate that some lesions of the nervous centers which disturb the action of the bladder do not cause complete paralysis of that viscus, for closure of the elastic urethro-vesical orifice is not interfered with, but its opening is impossible, owing to loss of the sensibility which is so necessary to convey the need to urinate. The pathic conditions which result from this loss of sensibility are contracture of the urethro-vesical region, stagnation and fermentation of the urine and cystitis. In a number of post-mortem examinations made upon cases of fracture of the spine with ensuing paraplegia, the bladder was almost invariably found inflamed, dilated, and sometimes thickened. In some cases surviving the injury several months phosphatic calculi were found in the bladder and in the renal pelves.

21. The four groups of aetical factors just described give rise to acute, sub-acute, and chronic cystitis. The symptoms of each of the three types of cystitis will next be examined.

22. The symptoms of cystitis vary according to the particular site, cause, severity, and stage of the inflammatory process, but the several types present some symptoms that are common to all of them. These are disturbances in urination, pain, and deviations from the normal characters of the urine.

23. The earliest symptom of acute cystitis, whether of the body, lower fundus, or neck of the bladder, is unduly frequent urination. This is soon followed by spasm of the muscular coat excited by irritation of the congested mucous membrane; the urine intensifying this irritation may be decreased or increased in quantity, and may be of high or of low specific gravity. During the period of increase of acute trachelo-cystitis the urine is passed in short, interrupted spurts, or often in drops, with the greatest distress, and in some cases more than a hundred times in the twenty-four hours. Urination is often irrepressible and the garments are liable to be soiled with urine. In rare instances there is retention of urine. These anomalies of urination are due partly to swelling at the urethro-vesical orifice and partly to spasm of the whole bladder. The pain during urination extends to the distal extremity of the urethra in chronic as well as in acute and sub-acute trachelo-cystitis, but is most intense in the acute type when it is characterised by patients as scalding, burning; reaching its maximum of intensity during the expulsion of the last drops of urine, and is associated

with rectal tenesmus and sometimes uncontrollable defecation.

24. In cases of vesical injury, stone, foreign bodies, and retention of urine, there is pain in the bladder independent of urination, and this pain is often irradiated to the abdominal organs, to the lumbar regions, and along the nerves of the lower extremities, and is much intensified by sudden movements of the body. In cystitis of the neck and lower fundus the pain is aggravated by accumulation of fæces or by any other source of compression from the rectum. When the body of the bladder is implicated, the slightest pressure applied to the hypogastric region causes much pain.

25. The deviations from the normal character of the urine, in the case of acute cystitis, are increase of acidity, excess of uric acid, and the presence of pus and blood more or less in quantity. In trachœlo-cystitis attended with strangury, the small quantity of urine voided each time is mixed with blood and pus, and with mucus derived from the vesico-urethral region, the prostate, and the glands of the urethra. In cystitis due to stagnation of urine there is an abundant precipitate of ammoniomagnesian phosphates, and this urine is alkaline, slimy, highly purulent, and contains much exfoliated vesical epithelium.

26. The symptoms of chronic cystitis without obstruction of urination are of the same kind as, but of lesser degree than, those of acute cystitis; the presence in the urine of more or less pus and exfoliated vesical epithelium being among its essential characters.

27. The symptoms of chronic cystitis due to prostatic or urethral obstruction, are: frequent, difficult, and

painful urination; the small stream of alkaline, purulent urine being often interrupted, and the act of urination failing to relieve the bladder which may be much distended. This type of cystitis is accompanied with a dull, constant pain along the ureters up to the kidneys. The patients complain of lumbago and sciatica, and often seek the physician's advice for these aches rather than on account of existing urinary stagnation and cystitis.

28. The constitutional effects and symptoms vary with the intensity of the inflammation and also with its cause. In trachœlo-cystitis due to the extension of urethritis, the pain is rarely such as to cause much general disturbance, and there is no febrile reaction, no inconvenience except during urination. It is only when urination is very frequent, and accompanied with tenesmus, that the patient complains of being ill at ease, for he is sleepless, feverish at night, and loathes his food; but these symptoms are at their height during the period of increase which rarely lasts longer than three or four days.

29 In trachœlo-cystitis due to the action of cantharidine the constitutional symptoms are proportionate in degree to the amount of the poison absorbed. In moderate quantity, this poison causes only such general effects as are induced by pain and want of rest; but when the quantity of cantharidine is great, as when administered by the ignorant or by others with nefarious intent, the constitutional effects are often alarming and sometimes fatal.

30. Super-acute cystitis involving nearly if not all the tunics of the bladder is attended with very grave

symptoms, such as recurring rigors, constant fever, vomiting, general depression, and signs of general infection, or of intercurrent peritonitis.

31. When retention of urine occurs either in acute or in chronic cystitis and the bladder becomes much overdistended, the constitutional symptoms are of the gravest order and often point to a fatal issue.

32. The progress of cystitis corresponds in a great measure with its cause and type, with the previous condition of the bladder, and with the age, constitutional peculiarities, and general health of the patient.

33. Cystitis arising from deviations in quantity and quality of the urine continues as long as the exciting agent is operative, often long after this excitant is removed, and sometimes becomes chronic. In those cases arising indirectly from disturbance of the cutaneous circulation the cystitis has been observed to resolve in a few days, but occasionally it passes through its several stages and lasts many weeks or months.

34. Cystitis due to persistent hyperlithuria resolves very rapidly as soon as a suitable general treatment renders the urine innocuous; but when the hyperlithuria is overlooked, the inflammation invades the whole vesical mucous membrane and the sub-mucous connective tissue. Contracture, diminished capacity, and thickening of the bladder ensue, and the patient is much distressed by the very frequent and painful expulsion of purulent and bloody urine, even after the affection has become chronic.

35. Cystitis due to the action of cantharidine deliquesces in a few hours when the quantity of the poison absorbed is little, otherwise the inflammation is violent

and extensive and the urine is purulent for weeks or months.

36. The progress of the trachelo-cystitis which arises from the extension of inflammatory action of neighboring parts is very rapid when, under appropriate treatment, the period of increase is cut short, so that at the end of three or four days urination is less frequent and less painful. The tenesmus ceases, the urine is passed in larger quantity, and is clearer. In such cases resolution is effected in the course of eight or ten days. In severer cases, particularly when treatment is delayed, resolution is not complete under three, four, or six weeks, and in some instances the inflammation passes into the chronic state and the whole of the vesical mucous membrane may become involved. Cystitis from injuries of the bladder, and from other mechanical irritants, such as foreign bodies, calculi, etc., continues with more or less intensity until the irritant is removed, and may require very active treatment long afterward. After the ablation of benign new growths the inflammation rapidly subsides, not so with malignant disease or tuberculosis.

37. Cystitis arising from stagnation of urine due to urethral, urethro-vesical, or prostatic obstruction, is gradually and slowly developed, beginning sometimes with the characters of sub-acute and sometimes with those of chronic inflammation. In the case of obstruction from urethral stenosis, if dilatation of the stricture be effected before the bladder is very seriously damaged the inflammation is at least checked; otherwise ureteric and pyelic inflammation ensue, and the supervention of complete retention of urine from a debauch in wine and

venery is to be regarded as a very grave complication. Similar phenomena arise from neglected urethro-vesical obstruction. Another grave consequence of retention of urine may now be incidentally stated, and that is the profuse hæmorrhage which sometimes follows the too precipitate evacuation of the over-distended bladder in elderly men suffering from prostatic obstruction and cystitis. Polyuria also sometimes follows the precipitate evacuation of the distended bladder. It has been observed in several instances. In one case it reached half a liter per hour for twenty-seven consecutive hours. This is of course an extreme case, but it is not uncommon for the polyuria to exceed three liters in the twenty-four hours, either owing to renal sclerosis or hydronephrosis.

38. In the case of stagnation of urine from disease or injury of the nervous centers as well as from urethral or prostatic obstruction, unless evacuating catheterism be regularly employed, the inflammation progresses from bad to worse until the upper urinary organs are implicated. There is in these cases a great liability to calculous formation in the bladder and renal pelves.

39. The morbid appearances of inflamed bladders, as seen through the cystoscope or on examination after death, vary with the site, type, and stage of the inflammatory process.

40. In acute trachœlo-cystitis the mucous membrane is of a deep red color, highly congested, swollen, velvety, and sometimes softened and even granular.

41. When cystitis arises from friction by a calculus, it begins at the neck and trigone of the bladder. As the calculus increases in size, the inflammation extends to the whole of the lower fundus which is coated with a

layer of pus and exfoliated epithelium. The mucous membrane is sometimes ulcerated at one or several points when the stone is rough and of irregular form. The same changes occur from the irritation provoked by uneven foreign bodies.

42. Ulcerations and even perforation of the bladder coats have been caused by the prolonged retention of catheters, death occurring from the entrance of urine into the peritoneal cavity.

43. The irritant, whatever it may be, remaining undisturbed, the inflammation which it has caused sometimes extends to the sub-mucous coat where small abscesses form and discharge their contents into the bladder cavity, or increase in size and point inferiorly toward the rectum, anteriorly toward the pubes, or laterally, or posteriorly toward the peritonæum.

44. The constant spasmodic contractions of the inflamed bladder lead to increase of thickness of the muscular coat, to sclerosis of the sub-mucous and sub-peritoneal coats, and to permanent contracture of the viscus. In these cases the reticular layer of the muscular coat is often much thickened, so that the internal surface of the bladder is very irregular, rising into bold columns and bands resembling those of the heart cavities; hence the designation columnar bladder. In the spaces between large columns the mucous and sub-mucous coats are forced and form small diverticula capable of lodging bits of gravel or of retaining from a few centigrammes to three or four grammes of urine. The thin walls of these diverticula sometimes ulcerate and allow urine to escape into the ambient connective tissue, or into the peritoneal cavity. These "spontaneous perforations"

of the bladder were first well described in 1835 by Mercier. In much rarer instances the diverticula are few but large, and constitute true sacculation of the bladder, of which more anon.

45. The slimy urine drawn from the bladder in chronic cystitis has led to the erroneous designation of this affection as "catarrhal fluxion or catarrh of the bladder"; both terms having been used first by Lieutaud in the eighteenth century. The term catarrh of the bladder is misleading and tends to error in diagnosis and to consequent neglect of regular evacuative catheterism of the bladder. Slimy, purulent urine is the result of fermentation and the conversion of the urea in the urine into ammonium carbonate which possesses the property of rendering pus slimy by saponifying its contained fatty matter, and fermentation occurs when the urine is retained in the bladder by a material obstacle at the urethro-vesical orifice or in the urethra. The ammonia is not only the irritant cause of the suppuration, but the active agent in the conversion of the greater part of the pus into slime. Although many writers still specialise "catarrh of the bladder" as distinguished from chronic cystitis, it is well known that chronic cystitis does often exist without the urine being rendered slimy, but in such cases there is no hinderance to urination, no stagnation, no fermentation, no ammonia, and consequently no slime. The slimy urine, of the so-called "catarrh of the bladder," contains very little if any true mucus. That the slime is due to the action of ammonia upon pus is demonstrable by taking pus from any abscess, diluting it with water in a test-tube, and adding liquor ammoniæ. In a few moments the fluid becomes slimy and can only

be distinguished from slimy urine by absence of urinous odor, by its color, and by its not containing any of the elements of urine.

46. Among the illustrative specimens exhibited were some bladders whose walls were two centimeters in thickness. These specimens were taken from the bodies of men that had died after long suffering from urinary obstruction, stagnation of urine, and consequent cystitis and pyelo-nephritis. They were nearly all good examples of interstitial cystitis superadded to myxo-cystitis; the bladders being capacious. In a few cases only were the bladders shriveled and reduced in capacity to sixty centigrammes and even less. Yet both the large and small illustrated vesical contracture; neither being able to expel any urine. In nearly all the specimens the mucous membrane was thickened, red, and its vessels were gorged with blood. In some of them this mucous membrane was of a slaty hue. In one it was mamillated and œdematous. These bladders all contained a slimy, purulent, chocolate-colored, alkaline, fœtid urine, and the ureters and renal pelves were distended by this offensive urine. In some specimens the mucous membrane was coated with slabs of thick, adhesive pus miscalled false membranes and diphtheritic membranes. One of these specimens showed, while it was in a fresh state, the whole trigone to be covered with a thick layer of tenacious pus, and in many spots the mucous membrane, of a dark red color, appeared where the softer parts of the layer of pus had been washed away by a stream of water. The bladder walls were two centimeters thick, and the ureters and renal pelves were greatly dilated and correspondingly thick-

ened. These morbid states had resulted from a long-neglected urethral stricture. In two of the specimens nearly the whole mucous membrane was destroyed by tuberculosis which had affected also both kidneys.

47. Gangrene of the mucous membrane of the bladder is a rare occurrence even from violence. It has happened on the supervention of acute or super-acute inflammation in cases of chronic cystitis; also from unrelieved complete retention in cases of stagnation of urine, and from injury particularly in bladders containing very large calculi.

48. The diagnosis of cystitis is to be reached only through analysis of the causes and symptoms, supplemented by physical exploration. Frequent desire to urinate and pain are common to all types and stages of cystitis and vary only in degree. These two symptoms together suffice to establish the existence of cystitis. But to ascertain the cause of a particular attack of cystitis is sometimes very difficult and requires much cross-examination and a close analysis of the facts elicited from the patient.

49. Acute trachœlo-cystitis is known to exist when urination becomes very frequent, painful, and at times irrepressible; the urine, passed in small quantities, even in drops, being mixed with blood, especially during the emission of the last drops, when the pain is at its height; this urine at first containing a considerable proportion of mucus derived from the urethral follicles, and in two or three days some pus, except in trachelo-cystitis due to the extension of acute urethritis when pus is present in the urine from the beginning of the attack. Trachœlo-cystitis is a common complication of acute prostatitis

and gonecystitis whilst acute prostatitis and gonecystitis are rare complications of trachœlo-cystitis. Rectal exploration with the finger is therefore necessary to ascertain the existence or non-existence of prostatitis or of gonecystitis in any case of trachœlo-cystitis.

50. Sub-acute trachœlo-cystitis is known to exist by manifestations which are similar to, but of lesser degree than, those of the acute type. The introduction of a rectangular exploring sound is necessary to determine if this inflammation is the outcome of a vesical calculus or of the presence of a foreign body.

51. Chronic trachœlo-cystitis is usually associated with chronic prostatitis and sometimes with chronic urethritis. The question of its diagnosis has already been discussed in connection with chronic urethritis and of chronic prostatitis.

52. The diagnosis of sub-acute general myxo-cystitis provoked by deviations from the normal standard of quantity and quality of the urine is reached through the previous history of the patient, through the account of his ailment given by him, and through microscopic inspection of the urine. When such cystitis becomes chronic and is attended with frequent and painful urination, the whole bladder is soon contractured and its capacity markedly diminished. This is ascertained by the slow injection, through a soft catheter, of a warm sterile solution; the quantity of fluid tolerated indicating the capacity of the diseased bladder. In some cases the quantity of fluid tolerated is as little as sixty or even thirty grammes. This, however, is not the only type of cystitis in which contracture with diminished capacity of the bladder occurs. Such an untoward complication

may arise in cystitis due to nearly all the causes previously named, and is therefore to be taken into consideration in diagnosticating cystitis generally.

53. The diagnosis of chronic cystitis due to obstructed urination requires mechanical exploration of the urethra, urethro-vesical orifice, or prostate, and microscopic examination of the urine. If the obstruction be owing to a urethral stricture, it is revealed by the acorn-tipped bougie. If urethro-vesical or prostatic obstruction be the cause of the stagnation of urine, the rectangular sound demonstrates the existence of either, also the degree of induration of the bladder and of enlargement of the bands of muscle tissue of the reticular layer. Gross inspection shows the urine to be glairy, slimy; and this urine converts red litmus paper to blue. Microscopic examination of the urine brings into view innumerable crystals of the ammonio-magnesian phosphates, pus cells, and vesical epithelium. When no urethral, urethro-vesical, or prostatic obstruction exists, and the urine contains creamy pus and no slime, the origin of the pus presumably is pyelic; urethritis, of course, being excluded.

54. Cystitis, general or local, arising from calculi, from injuries, or from the lodgement of foreign bodies, requires for its diagnosis mechanical exploration of the bladder and microscopic examination of the urine.

55. When retention of urine complicates the acute or sub-acute type of cystitis, the severe pain seated in the hypogastric region is irradiated to the abdominal and lumbar regions, the tenderness and the tensive swelling in the hypogastric region, the straining during vain efforts to urinate, the flatness under percussion in

the region of the distended bladder, render the diagnosis of this complication comparatively easy.

56. When complete retention occurs in chronic cystitis due to stagnation of urine some of the symptoms enumerated in the foregoing note are ill defined, whilst others of a graver nature are manifested. For instance, the pain is dull but continuous, there is less tenderness and little or no tension in the hypogastric region, though the bladder may contain much more urine than in the case of retention in acute cystitis, and may project forward like a gravid uterus. Retention of urine in the acute cystitis of youth and middle age is sudden and causes great suffering; in chronic cystitis from prostatic obstruction it is very gradual and is sometimes undiscovered until the lower part of the abdomen begins to project, and until the sensation of fulness in that region and in the rectum is such as to arouse the sufferer's attention. In long-neglected cases the patients are enfeebled and emaciated, able to take but little food which is ill digested, the pulse is small and weak, the skin dry, slight rigors occur at night and are followed by febrile reaction and later cold sweating of a urinous odor. These are forebodings of serious renal implication.

57. The prognosis of cystitis is founded upon its cause, type, and complications, upon the previous condition of the bladder, upon the age, constitutional peculiarities and general health of the patient, and upon the degree of efficiency of the treatment.

58. The prognosis is favorable in cases of cystitis arising from the first, second, and third groups of causes when free from complications and attacking healthy adults; otherwise it is doubtful or even unfavorable, for

the inflammation may become unmanageable, may invade the upper urinary organs, and prove fatal in a few weeks or even in a few days. This is sometimes the case when acute or super-acute inflammation attacks a bladder that has long been diseased, as in the chronic cystitis from urethral or prostatic obstruction.

59. The prognosis is unfavorable in cases of long-neglected cystitis with contracture and diminished capacity of the bladder, particularly in old and feeble men. Younger subjects, free from urethral obstruction, withstand the incidental suffering much longer, and their condition is often greatly improved by treatment directed toward dilatation of the bladder. In some of these younger subjects it is possible to restore the normal capacity of the bladder even after the lapse of a year from the beginning of the affection, but not without the greatest patience and persistence on the part of the physician and the greatest endurance and determination on the part of the patient.

60. The prognosis is unfavorable in cases of cystitis due to grave disease or injury of the nervous centers. The patients are made comparatively comfortable and life may be prolonged by treatment, but the cystitis is never cured; renal complications finally arising to prove fatal.

61. The prognosis is more favorable in cases of cystitis due to prostatic obstruction in vigorous elderly men, provided they be subjected to regular catheterism and vesical irrigations tending to arrest urinary fermentation. The life of such patients is not materially shortened by this incurable affection if the local treatment be faithfully carried out.

XXI

URO-CYSTITIS; ITS MANAGEMENT*

1. The treatment of sufferers from inflammation of the urinary bladder should be moral and constitutional, as well as local. The general indications are: to use moral suasion with tact and skill; to relieve pain; to strive to remove the original cause or to shorten the period of resolution of the inflammation; and to prevent or to combat complications. The special indications vary in accordance with the exigencies of individual cases. The prime requisite to the rational management of a particular case of cystitis is the proper interpretation of its phenomena. This is possible only after the history of the case is known and the cause of the inflammation ascertained, and a close analysis is made of the subjective and objective symptoms.

2. Moral suasion is surely of very much importance, particularly in the management of hyperæsthetic subjects affected with any of the several types of cystitis. By the opportune and discreet use of persuasive language, the physician may reasonably expect to gain the patient's confidence, and by kind, soothing, encouraging words greatly relieve his mental distress, while by the judicious prescription of internal remedies and the skilful and gentle use of necessary instruments, he is

* The substance of these notes was extracted from Lecture VI in "*Diseases of the Urinary Apparatus.*"

striving to accomplish the cure or, at least, the alleviation of the bodily ailment.

3. Constitutional as well as hygienic treatment is clearly indicated in the divers types of cystitis. When a sub-acute cystitis is traced to supersecretion of urine of low specific gravity, the cause of the polyuria is first ascertained, and, if possible, removed; then the cystitis is likely soon to cease. For instance, when polyuria is due to temporarily disturbed innervation, the re-establishment of the nervous equilibrium is sufficient to effect the cessation of polyuria and thus remove the cause of the cystitis. This, however, is hopeless in some cases of disease or injury of nervous centers, as it is in certain lesions of the kidneys in which the polyuria is irremediable. In some cases of cystitis due to persistent polyuria, opium in moderate doses has the double effect of relieving pain and of lessening the urinary secretion. In other cases it becomes necessary to add to the opium either ergotin or gallic acid.

4. In cases of cystitis caused by diminished renal secretion, the urine being of high specific gravity and acrid, the treatment should be such as to excite an increase in the quantity of the urine and to render it bland. This may be accomplished by the judicious prescription of mild alkaline diuretics or by the citrate of soda largely diluted, or by the infusion of uva ursi or of triticum repens, and so secure the rapid subsidence of the cystitis.

5. Cystitis arising indirectly from disturbance in the cutaneous circulation ordinarily gets well when this circulation is re-established, and does not require other medication than such as will render the urine bland. But when the cystitis persists and vesical contracture

ensues in any of the varieties of the first group, a more active treatment is necessary, as will be stated presently.

6. Cystitis due to persistent hyperlithuria is of much more frequent occurrence than any of the varieties of this first group, and its management demands much attention. This variety of cystitis is often miscalled "irritability of the bladder," which symptom is treated with opium, belladonna, and other drugs, and the inflammation is thus allowed to progress until permanent contracture of the bladder is established. This cystitis is as amenable to treatment and to cure in its incipiency as it is refractory to either in its advanced stages, particularly after contracture of the bladder is confirmed, when there is little if any hope of cure.

7. If, when the bladder is said to be irritable, the urine is examined microscopically and found to contain an excess of uric acid, and treatment for hyperlithuria is at once instituted, normal urination is soon restored and all the symptoms of beginning cystitis vanish. Patients affected with cystitis due to hyperlithuria are all sufferers from dyspepsia, hepatic engorgement, costiveness, headaches, muscular pains, and other symptoms of leucomainal intoxication. Their treatment should therefore be directed to the restoration of the impaired digestive function and to the remedy of its consequences. For these ends the first prescription should be for a cathartic medicine; then for daily aperients and alkaline waters. When the urine contains a great abundance of uric acid crystals which are teasing and distressing the sufferer during his frequent acts of urination, nothing seems to afford such quick relief as four daily doses of fifty centi-

grammes of sodium salicylate largely diluted, but continued no longer than three days.

8. During this treatment and for three or four weeks thereafter, lithuric patients should make only very sparing use of starches and sugars, especially at the evening meal, and in some instances it becomes necessary to proscribe all carbohydrates. Abstention from all foods tending to cause flatulency, and from malt liquors, cider, or sweet wines, is essential. Sufficient bodily exercise, promotion of the cutaneous circulation by frequent ablutions and frictions, and clothing suited to the state of the weather, constitute the remainder of the hygienic management.

9. Such medication and hygienic precautions as the foregoing are more than likely to nip in the bud a cystitis which would otherwise become very distressing and lead to transitory and finally to permanent contracture with diminished bladder capacity. But contracture of the bladder, even of many months duration, is not necessarily a hopeless condition and is very often cured when subjected to early treatment.

10. The local treatment consists in the use of medicinal and mechanical means. When acute cystitis is accompanied with frequent and painful spasmodic contractions foreboding transitory contracture, the perinæum and hypogastrium should be leeched—six or eight in each region. Then hot fomentations to the hypogastrium for two or three days. This local depletion, so beneficent in young, robust subjects, should not be employed in the case of those whose health is otherwise impaired or those who are known to be intolerant of blood-letting in any form. Two or three liberal doses of opium or morphia

may be necessary to relieve the pain incident to the acute inflammation, and diluent drinks to keep the urine bland. A nightly hot hip-bath of five minutes' duration also serves the good purpose of relieving congestion. No instrument should be introduced into the bladder, except in the case of retention of urine which, however, is of extremely rare occurrence in these cases. After a few doses of one centigramme of belladonna extract or of one milligramme of hyoscyamia, the bladder begins to lose its sensitiveness and to allow itself to be distended by the bland urine. Resolution of the inflammation being fairly on its way, and the spasms having ceased, the patient is able, in a few days, to retain his urine, several hours and is soon well.

11. In chronic cystitis with contracture, if there is not much thickening or induration of the bladder walls consequent upon interstitial inflammation, mechanical as well as general treatment is required; the indications being to subdue the inflammation and to restore the normal suppleness and capacity of the bladder. The general treatment so valuable an adjuvant to the mechanical treatment should of course be continued until the cure is effected.

12. The inordinate irritability of the bladder and the accompanying unduly frequent and distressing urination incident to cystitis with contracture, react upon the nervous system to the extent of seriously disturbing sleep and rendering the patient excessively fretful. He is constantly on the alert for the moment to arrive when it is time to urinate, and ever ready to clutch any object that may serve as a fulcrum for his straining efforts. His face then becomes livid, and intense suffering is

thereon depicted. At the close of the act of urination he throws himself upon his bed exhausted, but not always to sleep, and in his short slumbers often dreams of greater distress. Day and night, every hour, half or even quarter hour the painful act is renewed. His physical strength is well nigh exhausted and his moral condition desperate. His skin is dry, harsh, and inactive, his digestion sadly impaired, his intestinal dejecta are hard and scanty, and he is, in no slight degree, under the influence of leucomainal intoxication. Such is a true picture of the worst cases. It is therefore wise to endeavor to remedy these several morbid states before they attain that high state of development.

13. The first prescription should be a cathartic. The next a dose of two grammes of sodium bromide with the object of inducing sleep and so prolonging the intervals of urination. Then thrice daily moderate doses of iron and quinine. Other medicinal agents that may be indicated should be used with due regard to the state of the digestive function, and not given beyond the point of tolerance. For instance, diluents should not be continued more than four days, to be replaced by balsamics which, in some cases act so favorably as modifiers of the urine; the balsamics in turn to be discontinued in favor of some diluent. Belladonna and opium and, for a change, hyoscyamia not more than one milligramme thrice daily, are all serviceable but should be discontinued in three or four days. Such are the chief agents required for the constitutional treatment, but they should be used with discretion, otherwise the desired effect is surely frustrated.

14. The mechanical treatment consists in vesical irri-

gations designed not only to disinfect the bladder but to effect its gradual dilatation as preventive of its permanent contracture. For vesical irrigation and dilatation in cystitis with spasmodic contracture, sundry solutions such as those of boric aid, of phenol, or of potassium and zinc permanganate are used with good effect, and in case of abundant phosphatic precipitate, the acetate of lead solution is of the greatest service when used according to the directions of Hoskins—but more of this later. It is highly beneficial, from time to time in the course of this treatment, to change the formulæ of the fluids to be injected, but it is essential to bear in mind the main object of restoring the normal suppleness and capacity of the bladder as speedily as possible by the simplest and safest means.

15. It may be of interest to note the many different substances that have been employed for vesical injections during the eighteenth and nineteenth centuries. Chopart seems to have been among the first to resort to vesical irrigations for the cure of cystitis, although the early lithotomists, among them Franco, used warm vesical injections as part of the after-treatment of lithotomy to cure any lingering cystitis, and although in the beginning of the eighteenth century Pierre Desault, of Bordeaux, had used, in calculous cystitis, injections of the alkaline mineral water of Barèges. Chopart at first made use of simple warm water, then of barley water, and afterward of lead acetate dissolved in water. In England and France, other physicians used flax-seed water, soot water, tar water, calomel suspended in acacia gum mucilage, wine, normal urine, etc., etc. Still later were used copaiba balsam in emulsion, carbonic

acid gas, solutions of sodium hyposulphite, potassium bromide and iodide, tincture of iodine, mercuric chloride, sodium chloride, sodium carbonate, silver nitrate, zinc sulphate, alum, tannin, strychnin, morphin, quinin, salicylic acid, resorcin, methylanilin, hydrogen peroxide, divers mineral waters, etc., with varying bad results, partly because no attempt had been made to gradually dilate the contracting bladder.

16. Gradual hydraulic dilatation of the diseased bladder, as employed by Civiale and others of his time, appears to have been set aside by many who were allured by the quicker and seemingly more promising method of sudden dilatation aided by induced general anæsthesia. The quick method, which does serious violence to the bladder, is generally unsafe, often dangerous, and seldom, if ever, successful. The slight benefit it very exceptionally confers is of short duration, and the cystitis soon recurs in even a more aggravated form. The advocacy of sudden distension of the bladder with a silver nitrate solution of two grammes to thirty grammes, is surely unwarrantable. This rash procedure has been used by many who have had good reason to regret it, for when the patients have survived the violence and the extensive cauterisation, their bladders have become permanently and incurably contractured, stenosed, and thickened from the consequent interstitial inflammation.

17. Nitrate of silver, in obstinate cystitis, is unquestionably a valuable therapeutic agent when used in solutions of suitable strength, but very strong solutions not only fail to cure but do irreparable mischief. In the latter part of the eighteenth century solutions of the nitrate of silver were used, in cystitis, as strong as

the extension of acute urethritis, consists in recumbency, a light regimen, the administration of diluent drinks to render the urine bland, the use of belladonna and opium by mouth or rectum, of hot fomentations to the hypogastric region, and of daily hip-baths. In ordinary cases this treatment suffices to induce resolution in the course of a week or ten days. In such cases balsamics serve no good purpose. Other cases, attended with very painful and difficult urination, require local depletion such as may be effected by leeching the perinæum, and the substitution of cold for warm applications; the cold being applied within the rectum by means of ice suppositories. No instrument should be passed into the urethra except in the event of urinary retention. In the severer cases it is necessary to give free doses of alkalies, and to increase the dosage of belladonna and opium. Though the pain and urgent and frequent urination diminish under this treatment, resolution is often incomplete and the affection becomes chronic. It is in these chronic cases that Guyon's method of instillations of silver nitrate solution is of the greatest service.

21. The treatment of calculous cystitis or of the disturbance caused by the presence of a foreign body is often necessary as a preliminary step to the removal of either irritant. The bladder may be spasmodically contracted around the calculus or the foreign body to such a degree as to interfere with the free play of the instruments used for the removal of the intruder. In such a case the preparation to the operation begins with the administration of a few doses of belladonna and opium for two or three days. During this time the

bladder is daily irrigated with a warm, soothing antiseptic solution; dilating it gradually as much as may be necessary for the safe trituration of the calculus or the extraction of the foreign body. Either operation being successfully performed, the after-treatment consists in daily irrigations tending to cure the inflammation and to restore the normal suppleness and capacity of the bladder.

22. Cystotomy, infra- as well as supra-pubic, has been frequently resorted to, during the past fifty years, with intent to cure obstinate cystitis and contracture of the muscular coat uncomplicated by a vesical tumor, stone, or foreign body, or by prostatic enlargement. The alleged effect of this operation is that it affords complete drainage of, and rest to, the bladder, and therefore cures the cystitis and contracture. The analysis of a considerable number of reported cystotomies for uncomplicated chronic cystitis shows that the relief afforded by the drainage was only temporary, and that they had failed to cure the cystitis and contracture. It is neither possible nor would it be desirable to keep open the neck of the bladder, even after lithotomy, for then, notwithstanding the use of dilating instruments or the insertion and retention of a large tube—which acts injuriously as a foreign body—cicatrisation of the urethro-vesical cut occurs in the course of two or at most three weeks, and hinders the involuntary flow of urine and so defeats drainage. In the case of supra-pubic cystotomy, a fistula has been kept patent for many months, and in some cases for years, without curing the cystitis or the contracture. The prescription of "long rest" to the bladder in these cases does not seem rational, since it

is well known that the prolonged immobilisation of any limb or part so surely leads to its permanent contracture. The muscular walls of the bladder need to be exercised in cases of cystitis with contracture which has not become permanent, and this exercise is attainable by artificial hydraulic dilatation which gradually restores its suppleness and capacity. From the foregoing statement it is fair to conclude that no cure need be expected from rest and drainage of the inflamed and contractured bladder and that cystotomy is not necessary.

23. In the management of cystitis due to urethral stenosis the physician is guided by the character, site, and caliber of the stricture, by its complications, and by the general physical condition of the patient. If the stricture, though narrow, is free from complications and susceptible of expansion, its gradual dilatation is at once begun and practised every third or fourth day. As soon as the urethral canal is thus sufficiently enlarged at the strictured point to render urination moderately free, the acts are less painful, less frequent; the bladder is soon emptied spontaneously, and the cystitis begins to subside, to be well, as a general rule, when the urethra is dilated to its normal caliber. When, however, the stricture is not dilatable beyond three or four millimeters, it should be incised longitudinally from within, and a catheter should then be used to draw off the purulent urine and to permit the thorough cleansing and disinfection of the blader. The catheter is afterward introduced for every act of urination, and the bladder washed once each day until there is no sign of cystitis. If there happens to be vesical contracture, gradual hydraulic dilatation becomes necessary. When internal urethrot-

omy is contra-indicated by reason of the extreme narrowness of a stricture seated in the scrotal or perineal region, especially if there be a urinary fistula or an abscess, the operation of external perineal urethrotomy should be performed without delay, to give vent to the urine; but this urine should be drawn off by means of a catheter passed through the wound, and the bladder washed once or twice daily. If there be no serious complication toward the upper urinary organs, the cystitis is likely to be cured or nearly so, before the external wound is fairly healed.

24. The cystitis of elderly men affected with prostatic enlargement requires unremitting attention from the earliest period of its development because of the grave consequences of neglect to relieve the bladder of the stagnant urine which so surely undergoes fermentation and the conversion of its urea into ammonium carbonate, besides causing an extension of the inflammatory process to the whole of the vesical mucous membrane and even to its underlying coats. This cystitis is generally of slow development. At first the urine contains very little pus; only the lower fundus of the bladder being affected. The amount of residual urine may not exceed thirty grammes, but this residuum gradually increases until the bladder is abnormally distended. The urine is then ammoniacal, slimy, fœtid, and urination is unduly frequent and very painful. If before the cystitis reaches this state of development the catheter is used once or twice daily and the bladder is properly cleansed by means of mild antiseptic irrigations, further fermentation is prevented and the inflammation subsides. But if the cystitis has already reached the entire mucous membrane,

proper measures should be taken to check the ammoniacal conversion of the urea and to counteract its ill effects. The amount of urea metamorphosed into ammonium carbonate is not less than fifty centigrammes to thirty grammes of urine. This percentage of ammonium carbonate is quite sufficient to excite cystitis, to act upon the albumin of the dead leucocytes, and to saponify the fats of the pus; the result of these changes being the slime, miscalled "ropy mucus," which is sometimes so tenacious that it cannot be extracted through an ordinary catheter. There are two ways of relieving a bladder gorged with tenacious slime. One is to convert the carbonate into an acetate of ammonium by throwing in largely diluted acetic acid—say a five per cent. mixture —which, in a moment, liberates the fats and liquefies the slime; the resulting fluid having a milky appearance. The other way, the more tedious, is to remove the slime by aspiration through a large catheter. The bladder is then to be emptied by means of an ordinary soft catheter five or six times in the twenty-four hours and cleansed with an antiseptic solution night and morning as long as the urine is alkaline; but when it resumes its normal acidity, the injections need not be used more than twice a week, the daily use of the catheter, however, should be continued. In case the urine is loaded with phosphates, the best way of ridding the bladder of their irritating effect is to use the acetate of lead solution as prescribed by Hoskins, or to inject water slightly acidulated with hydrochloric acid, preferably the first. These two means constitute the true prophylaxis of phosphatic stone.

25. One of the gravest consequences of the cystitis

of elderly men suffering from prostatic obstruction is contracture with diminished capacity of the bladder. This, happily, is of comparatively rare occurrence, whilst contracture with increased vesical capacity is the rule. Sufferers with contracted bladders are incessantly tormented by frequent and urgent desire to urinate accompanied with painful straining and all the other pangs of acute retention of urine. They are thereby prompted to use the catheter every half hour, but without relief. Their bladders are intolerant of artificial hydraulic dilatation beyond sixty grammes of a warm solution whose density is increased by the addition of a little glycerin. The great distress of these hopeless cases is mitigable only by an occasional free dose of belladonna and opium and two or three daily irrigations of the bladder with the warm solution already mentioned.

26. The physician is sometimes called upon to minister to the suffering caused by complete retention of urine—another grave complication of the cystitis arising from stagnation of urine due to prostatic obstruction. His duty, in such a case, is to ascertain the degree of enlargement of the prostate and the exciting cause of the occlusion of the urethro-vesical orifice. He may learn, by persistent cross-examination, that the sufferer has been exposed to inclement weather, or that he had committed some excess, or that the rectum had not been relieved for several days, etc. He may also learn how long since the bladder had been emptied, whether a catheter had been used, and if so what kind of catheter; if catheterism had been unsuccessful, how many times it had been tried; whether hæmorrhage had followed the attempts made to enter the bladder, and whether

the patient had had chills after the catheterisms. Then he should make a general examination of the case to ascertain the condition of the patient and the degree of distension of the bladder. If there be much constitutional and cardiac disturbance, catheterism should be delayed until the needed restoratives have had their effect; so about an hour after the administration of a stimulating drink and a broth, the patient being thus braced up, a No. 9 soft elbowed catheter is introduced and half a liter of urine drawn off, and in two hours another half liter, and so on every two or three hours until the bladder is finally emptied. The reason for these measures was given under the head of retention of urine in elderly men. If, on account of a rent in the floor or either side of the prostatic sinus, the point of the catheter is arrested and fails to enter the bladder, the instrument should be withdrawn and armed with a suitably curved metallic stylet and re-introduced after William Hey's method which has already been described. In case of failure with Hey's method, Mercier's invaginated catheter may be substituted with the fairest prospect of success. This ingenious contrivance, also described elsewhere, has often obviated puncture of the bladder which should only be performed, for temporary relief, in case suitable catheters cannot be procured for many hours.

27. In case of multiple false routes in the prostatic region and failure of all methods of catheterism, the patient, under anæsthesia, is placed in the lithotomy position and a grooved staff is passed into the urethra as far as the obstacle. The membranous urethra is laid open longitudinally, a broad-grooved director is inserted

along the groove of the staff or guided into the bladder by the left index finger, and a deep, downward cut made in the median line through the base of the prostate, and the central or such other part of the organ as may be enlarged, at once enucleated as described under the head Prostatectomy. If there be only a contracture of the vesical neck or a thin "bar," the deep incision at the prostatic base will generally suffice. Then an India-rubber tube is passed into the bladder, through the perineal wound, and retained in position forty-eight hours. Meanwhile the bladder is irrigated twice daily until complete cicatrisation of the wound.

28. When the over-distended bladder has been precipitately emptied and an abundant hæmorrhage has ensued, this viscus should not again be allowed to become distended, and means should be promptly taken to arrest the hæmorrhage. In such a case, may be administered, twice daily, one gramme of ergotin or of gallic acid, or of quinine. Vesical injections of cold water, slightly acidulated with acetic acid, may be made after each evacuating catheterism. It is essential that the bladder be kept empty. So long as the urine is much in excess of the effused blood, this blood retains its fluidity, but when the blood is in excess coagulation occurs rapidly and the bladder is soon distended with dense clots which cannot be extracted until they are broken up and removed by aspiration through a large catheter. This question will be more fully discussed under the head of Bladder Hæmorrhage.

29. The cystitis due to disease or injury of the nervous centers requires early detection and close attention. In patients who survive grave lesions of the brain or

of the spinal cord for weeks or months, it has long since been observed that frequently the immediate cause of death is traceable to consecutive lesions of the urinary organs, such as calculous formation, cystitis, ureteritis, and pyelo-nephritis, all arising from stagnation of urine in the bladder whose sensibility is blunted or even destroyed, owing to the nerve-center lesion, and that when early attention is given to the impaired urinary organs while the primary disease or injury is undergoing treatment, the life of the patient is prolonged and his suffering lessened. The needed treatment is simple and effective so far as the urinary organs are concerned. Very soon after a patient has become paraplegic, his bladder ceases to act and so rapidly fills with urine that it must be artificially emptied before it becomes over-distended. As long as the urine is clear and of acid reaction, simple evacuative catheterism, practised at regular intervals, suffices to prevent stagnation and decomposition of the urine and consequent cystitis. But when the urine is already turbid and alkaline, the bladder should be irrigated once or twice daily with suitable solutions. This plan of treatment has been current in Bellevue Hospital for the past forty years, and it is believed that the lives of many patients have thus been prolonged for months and even for years. Experienced surgeons know so well how commonly, in depressed fractures of the skull, the bladder becomes distended with urine, that the first direction they give to their aids is to empty the patient's bladder, with the object of preventing over-distension and cystitis.

XXII

BLADDER CONTRACTURE; ITS NATURE AND TREATMENT

1. That rigidity of the muscular layers of the urinary bladder consequent upon cystitis and designated, in modern times, as contracture, is manifested, at first, by frequent and progressive spasmodic contractions with much distress of body and mind, and later by the permanent rigidity formerly styled "tonic spasms."

2. The word contracture was long ago offered, by French writers, as a substitute for the Sauvagian term "tonic spasms," and has ever since retained its new significance although the Latins had used *contractura* synonymously with *contractio*. But to the first is now given a different meaning from the alleged synonymous term, for it has been shown that simple contraction of muscular tissue is very soon followed by a notable period of repose, whilst the period of repose is scarcely appreciable in contracture during its early existence and practically abolished in its advanced stage.

3. Contracture of the bladder may be transitory or permanent; transitory when its cause has existed but a short time and can be speedily removed; and permanent when this cause has lasted a year or years. The contracture may be general, that is to say may involve the whole of the muscular structure of the bladder, or local and affect only the bands of muscle tissue which act upon the vesico-urethral outlet. It occurs in youth,

middle life, and old age. Often it is not recognised until it has become irremediable. But when discovered during an early period of its existence it can be soon remedied by general and local means.

4. Among the many causes of cystitis accompanied by contracture of the bladder, are: (*a*) any marked deviation from the normal standard of quantity or quality of the urinary secretion; (*b*) stone in the bladder; (*c*) foreign bodies in the bladder; (*d*) certain uterine displacements; (*e*) villous tumors in the female urethra; (*f*) acute urethritis in the male; (*g*) obstruction of the urethro-vesical orifice by an enlarged prostate; (*h*) stricture of the urethra; (*i*) chronic urethritis; (*k*) disease and injuries of the nerve centers; (*l*) anæsthesia by ether. To this list of causes may be added tumors of the bladder, too frequent and violently-performed catheterism, fæcal accumulation in the rectum, anal fissure, hæmorrhoids, etc.

5. *a*. Men with disturbed innervation, and also hysterical women frequently suffer from cystitis and finally from vesical contracture due to the long continuance of an abnormally abundant secretion of pale urine of very low specific gravity. The immediate effect of this unnatural flow of urine is rapid distension of the bladder, to which this organ is unaccustomed; here, then, is the first disturbing element. If this polyuria continue unchecked, even for a few weeks, the quantity of urine passed each time, at first large, soon diminishes at each act of micturition, but the desire to urinate is more urgent, the intervals shorter, and, at length, the act becomes extremely painful from violent spasmodic contractions of the bladder. If the urine be then examined micro-

scopically, it is found to contain a large amount of vesical epithelium washed away, as it were, by a great flood. In fact, the mucous membrane has become water-logged as it does from too frequent and abundant vesical irrigations. Thus, in a measure deprived of a part of its epithelium, the bladder can no longer resist the irritating effect of the urine, becomes inflamed, loses in a great degree its retentive power, and may soon be in a hopelessly contractured state.

6. The other extreme is seen in those cases in which the urine is of very high specific gravity, such as in many instances of saccharine diabetes. In these, also, cystitis occurs and contracture is the outcome if the cystitis be not kept under control. Cystitis does not invariably exist in all cases of confirmed glycosuria, but is of frequent occurrence in such cases and in some of these there may be an undiscovered predisposing cause.

7. It may be asked why, if urine of low specific gravity be an irritant, is urine of high specific gravity equally an irritant? The answer ventured is that in the case of urine of very low specific gravity the superficial stratum of epithelial cells, by an endosmotic process, swell, die, and are cast off; and in the case of urine of very high specific gravity the epithelial cells, by an exosmotic process, shrivel, die, and are cast off; in both cases leaving a denuded surface upon which the urine acts injuriously.

8. Purulent urine from pyo-nephrosis often causes cystitis with inordinate vesical spasms. Highly acid as well as highly alkaline urine is a sore irritant to the vesical mucous membrane, for, when overcharged with uric acid, calcium oxalate, or the phosphates, it creates a

sufficiently great mechanical irritation to give rise to cystitis and general vesical contracture.

9. Urine rendered acrid by the habitual ingestion of some poisonous substance such as opium; by the immoderate use of ardent spirits and of new beer; by the excessive ingestion of some of the balsamics, of turpentine, of cantharides, etc., may be added to the exciting causes.

10. *b, c.* The presence in the bladder of a urinary calculus or of a foreign body, in a comparatively short time causes cystitis with spasmodic contracture; the stone or foreign body sometimes being firmly grasped by the convulsed bladder. Such cases often give no little trouble and anxiety to lithotriptists, and induce many to resort to cystotomy. But this spasmodic contracture of the bladder can be brought under complete subjection by patient and gentle management in the course of ten days or two weeks, when it will be possible to crush the stone or extract the foreign body.

11. *d.* Certain uterine displacements have been known to cause vesical inflammation with "tonic spasms" by mere mechanical pressure and by encroachment upon the bladder cavity; a condition long ago fully recognised by gynæcologists. Many years ago the writer saw, with the late George T. Elliot, a woman who was dying from the consequences of chronic cystitis, with extremely painful "tonic spasms," caused by an anteverted uterus which had become adherent in its abnormal position and could not be replaced.

12. *e.* Villous tumors in the female urethra sometimes cause cystitis with very distressing vesical spasms which, if not promptly relieved surgically, end in permanent

contracture. The writer has had under observation six such cases, one of which was in a child about five years of age. He clipped off with scissors from the urethra two villous tumors which had impeded urination, and for some time, caused painful vesical spasms and finally, retention of urine. The operation gave such speedy relief that the patient was soon dismissed. The second case was that of a lady fifty years old who could not retain her urine more than ten minutes owing to the existence of several small villous tumors in the urethra. Excision of these growths and a few months of local and general treatment restored the retentive power of the bladder to a quarter of a liter. She was heard from ten years after and reported herself as entirely free from her former trouble. The third was a lady of sixty-four who, for fifteen years, had suffered from constant vesical irritation, due, as was ascertained on examination, to the presence of three urethral villous tumors which were excised. The urethra was then dilated or rather divulsed to the extent of admitting the index finger. The bladder was contractured, indurated, much thickened; and diminished in capacity to fifteen grammes. In the next eight years it was not possible to bring up its retentive power to more than one hundred and twenty grammes, nor was it thought safe to undertake to do more than had already been accomplished by persistent hydraulic dilatation. The patient was otherwise well and lived to the great age of eighty-four years. The details of the last three cases need not be given. The fourth case was similar in result to the third; that is to say, the capacity of the bladder could not be increased beyond one hundred and twenty grammes. The fifth

and sixth cases were cured completely by the operation and after-treatment.

13. *f.* Acute virulent urethritis in the male sometimes extends its infection to the bladder, causing such violent spasms, that if the urethra were as broad and short as in the female, the mucous membrane would be extruded after the manner of a prolapsus ani. A patient affected with that kind of cystitis was heard, in his great agony, to say that it seemed to him as if his bladder would be forced out of his body. The man was young and robust, with wonderful power of resistance to physical ails, so he made a good recovery, but not until he had undergone a very active course of general and local treatment for several months. Some of the most obstinate cases of chronic cystitis with permanent contracture, sclerosis, thickening of all the bladder coats, and extremely diminished vesical capacity, have been the outcome of virulent urethritis and have finally succumbed to pyelo-nephritis.

14. *g.* Prostatic obstruction, even for a short time unrelieved, causes a more or less obstinate cystitis, and almost always some thickening and contracture of the muscular wall of the bladder. The first effect of obstructed urination from enlargement of the prostate is a series of frequent and violent contractions of the bladder, which is incessantly wrestling with the urethro-vesical obstacle to be rid of its fluid burden, but only a small quantity of urine is expelled at each contraction. The struggle between the bladder and the unyielding obstacle continues week after week and month after month until not a single drop of urine can escape. The muscular wall is then thickened in no little degree and

its contractions cease owing to over-distension of the organ with urine which dribbles from over-flow. The violent contractions referred to above are caused, not by a little irritating urine or by great floods which wash away the epithelium, but often by bland urine which has slowly and gradually accumulated in the bladder despite its efforts to expel it, has there stagnated, become alkaline, and caused inflammation of the dilated lower fundus. It should be said parenthetically that the epithelium of old men's bladders, possibly from the presence of an increased amount of silicious substance, has a greater power of resistance against irritating urine than that of young subjects. It is known that catheter sm and certain other operations are better tolerated by the urethræ and bladders of the aged. The contractured thickened bladders of the old increase rather than diminish in capacity. One of the worst pathic calamities that can befall an aged man, suffering from the consequences of prostatic enlargement, is contracture of the bladder with excessive diminution of its capacity; but fortunately this is rare, while distension of the thickened bladder is the general rule. From the fact that the urine, flowing even through a catheter, is not expelled in a jet but rather slobbers, it is often said that the bladder is "atonied." The truth is that there is anything but atony in this case. There are, in reality, "tonic spasms," thickening of the muscular substance, and finally sclerosis of the connective tissue.

15. *h*. In neglected urethral stricture enough urine stagnates in the lower vesical fundus to cause cystitis with painful spasmodic contractions. At length complete retention of urine occurs, this serious complication

requires the most careful and skilful management. The bladder, as in the case of obstruction to urination from enlargement of the prostate, may be dilated and at the same time contractured and thickened, or its capacity may be extremely diminished—a sad and almost irremediable condition even after enlargement of the strictured part of the urethra. But ordinarily, when the contractured bladder is dilated and thickened, its condition is greatly improved after relief of the stricture.

16. *i.* When chronic urethritis extends to the prostatic urethra and vesical orifice, it sometimes causes a degree of contracture of the neck of the bladder sufficient to impede micturition and cause stagnation of urine, inflammation of the lower fundus and, at last, general vesical contracture. This condition, so well described by Mercier, is very often overlooked or mistaken for prostatic obstruction.

17. *k.* Certain diseases and injuries of the nervous centers are followed by retention of urine said to be due to paralysis of the bladder. In true paralysis of the bladder, incontinence and not retention of urine should occur. But it has been shown that lesions of the nervous centers which disturb the action of the bladder do not generally cause paralysis of that viscus, but contracture of its neck and consequent retention of urine. In a considerable number of necropsies of cases of fracture of the spine with paraplegia, the bladder was found inflamed, thickened, and dilated; and all of these lesions have surely been due to the stagnation of urine from urethro-vesical obstruction caused by the local contracture.

18. *l.* One of the last of the exciting causes enumer-

ated above is given as a warning to surgeons who make free use of ether as an anæsthetic agent. In thirty cases out of one hundred operated upon for hæmorrhoids, the ill results upon the bladder were attributable to the remote effects of this anæsthetic agent. The same effects have been noted after operations, performed in other parts of the body, necessitating the use of much ether to prolong the period of anæsthesia. This anæsthetic agent operates in two ways: first, upon the kidneys, by which it is largely eliminated, causing primarily congestion and oliguria followed by polyuria; secondly, the urine containing ether though irritating is not distressing, because of the semi-consciousness of the patient who can feel no urgency to expel it; then, by the time he has regained complete consciousness, the bladder is already so much distended that he is unable to pass any urine, and, for his relief, recourse is had to the catheter whose use is rendered necessary for many days or even months after the prolonged administration of ether. The retention of urine, in such cases, is due to spasmodic contracture of the neck of the bladder. The over-distension itself causing a more or less obstinate cystitis, which often ends in permanent general contracture and thickening of the bladder. To avoid these sad results, an endeavor should be made to prevent distension of the bladder, by asking the patient to urinate before the operation, and again as soon as he begins to regain consciousness. These simple injunctions and means often avert a troublesome attack of cystitis and its ill consequences.

19. Cystitis, as already noted, is the chief factor in vesical contracture which in its early stage consists in

distressful spasms often followed by the escape, every ten or fifteen minutes, of a little turbid, purulent, and sometimes bloody urine that later ceases to be expelled in a jet and slobbers out. In such cases, the pain felt in the urethral canal and in the glans penis is so closely like that caused by the presence of a stone in the bladder that the surgeon is impelled to use his searcher and clear all doubt. Contracture limited to the urethro-vesical fibers soon opposes a strong barrier to normal micturition in consequence of which the urine stagnates in the lower fundus to increase the existing mischief. Patients thus attacked suffer from more or less fecal accumulation in the lower rectum or from hæmorrhoids and from sciatic and anterior crural neuroses. "The inordinate irritability of the bladder and the accompanying distressing and frequent urination incident to cystitis with contracture, react upon the nervous system to the extent of seriously disturbing sleep and of rendering the patient excessively fretful. He is constantly on the alert for the moment to arrive when it is time to urinate, and ever ready to clutch any object that may serve as a fulcrum for his straining efforts. His face then becomes livid and intense suffering is thereon depicted. At the close of the act of urination he throws himself upon his bed exhausted, but not always to sleep, and even then he often dreams of his distress. This scene is renewed every hour, half hour, or even every quarter of an hour. His skin is harsh and inactive, his digestion is soon impaired, his appetite vanishes, his intestinal dejecta are hard and scanty, and he is in no slight degree under the influence of leucomainal intoxication. Such is a true picture of the

worst cases. It is therefore wise to endeavor to remedy these several morbid states before they attain this high state of development."*

20. The general treatment of vesical contracture should consist in the administration of remedies which tend to mitigate pain by their action on the innervation of the affected parts, and also by their power of modifying the urine. In the first instance opium may, with great benefit, be given in a few free doses that will make a decided impression upon the nervous and arterial systems; but small doses, long continued, should be avoided as positively harmful—except in polyuria—for opium so given diminishes the urinary secretion and renders the urine acrid and irritating. Another valuable medicinal agent is belladonna; but this drug cannot be given for more than three or four days in succession, on account of its very unpleasant toxic effects, even when not more than one centigramme is taken three or four times daily. It is better tolerated when given in combination with opium. Good results have been obtained from hyoscyamus extract, fifteen or twenty centigrammes per day; also from hyoscyamin, in doses of one milligramme three times a day, in the form of tablets, for three or four days.

21. In case of polyuria opium is of great value in small doses but should not be given for any great length of time, partly on account of its after effect on the sufferer who is not unlikely to become addicted to its excessive use after recovery. Gallic acid also has been given in one gramme doses with good effect toward lessening the superabundant urinary secretion; and er-

* Diseases of the Urinary Apparatus, p. 137.

gotin in fifty centigramme doses twice or thrice daily has a similarly good effect on polyuria. When lithuria exists, it should receive its appropriate medicinal and hygienic treatment. A combination of hyoscyamus or belladonna with largely diluted citrate of soda, in such cases, is of great service for five or six days.

22. In cases requiring a chalibeate, the tincture of chlorid of iron answers well in fifty centigramme doses twice daily. Quinine in small quantities is worthless if not harmful. Not less than fifty centigramme doses should be ordered. Strychnine is particularly injurious when its use is long continued. It is entirely too much used in affections of the urinary organs. Salicine, in doses of seventy-five centigrammes two or three times daily, has an excellent effect in mitigating the pain of those neuroses which so often complicate vesical contracture.

23. Local treatment plays the chief part in the management of vesical contracture, but this local needs to be supplemented by a vigorous general medication, especially in cases of transitory contracture, with frequent and painful micturition, due to acute cystitis occurring in young subjects as that mentioned in note 13. Such sufferers require a medication which should begin with the administration of a brisk saline cathartic, to be soon followed by liberal doses of opium and belladonna to relieve spasm and pain, then by the free use of diluent drinks. The effect of these active measures will generally be a rapid subsidence of the torment caused by the spasms and by the passage of irritating urine through the urethra. Local depletion by means of leeches applied to the perinæum or hypogastrium is

indicated only in robust subjects. In the case of intolerable distress during and after urination—the spasmodic contractions having resisted the action of the opium and belladonna already administered—it is justifiable to use, for local anæsthesia, a four per cent. cocaine solution thirty grammes of which may be thrown into the bladder if only for very temporary respite; but this should not be repeated on the same day. Irrigations intended to effect distension of the bladder should not be employed in cases of spasmodic contracture due to acute cystitis; for obvious reasons. Ordinarily the spasms so lessen in the course of a few days that the bladder begins to bear some distension by the urine, and the patient is in a fair way to recovery. Such is what may be expected from the treatment of spasmodic contracture due to acute cystitis.

24. When the cystitis is sub-acute, or already chronic, the consequent contracture is curable if it have not become permanent and is not accompanied with sclerosis of the connective tissue and inordinately diminished vesical capacity. The local treatment should be directed to the relief of the cystitis and of the contracture at the same time, and should consist in the slow, gradual, and progressive hydraulic dilatation of the bladder, so successfully employed by Civiale and by others of his time, and so little used at present. That excellent plan of treatment was set aside by many physicians who were allured by what seemed to them a more promising and quicker mode of dilatation which, in reality, was seldom successful, always unsafe, and often dangerous even to the bursting of the bladder. To effect this fatal sudden dilatation of the contractured bladder, the operator has

generally subjected the patient to anæsthesia so that he might tolerate, for the time being, its cauterising action, when a large dose of silver nitrate is added to the fluid injected. One of the cases so treated, by a strong advocate of the method, was an elderly man whose much contracted bladder was rapidly distended by the forcible injection of a solution of nitrate of silver, one gramme and five-tenths to thirty grammes of water. When seen by the writer, the sufferer was in a hopeless condition consequent upon that harsh treatment. In any case, such a heroic operation is certain to render incurable a bladder likely to have yielded to slow, gradual dilatation.

25. Gradual dilatation of the contractured bladder is accomplished after the following manner: The urine is first drawn off through a soft catheter and measured. If it be found that the actual retentive power of the bladder is as little as thirty grammes, the same quantity of any warm, sterile, unirritating fluid of about the density of normal urine, is slowly thrown in and at once allowed to escape; a second injection slightly in excess of the first is then made, treated as before, and measured to ascertain what gain has been obtained. After a third injection, greater in amount than the second, it is known whether or not the bladder is likely to yield easily to the hydraulic pressure. Ordinarily, not more than three injections need be made at each sitting and there should be but one sitting per day. In certain instances the daily gain is only a few centigrammes, in others a gramme, and so to thirty grammes. In any case, when the escaping fluid is even slightly colored with blood, the distension should not be carried farther during the sitting and the amount of fluid injected

afterward should be only a little increased. By this very slow process there will be sufficient gain at each sitting to ensure safe dilatation of the bladder which will thus be effected in the course of three or four weeks perhaps to the extent of augmenting its retentive power to a quarter or even to half a liter.

26. "A very important point, to which the attention of the physician should be directed, is the habit that some patients, affected with cystitis and contracture, form of urinating, so to speak, by the clock. Unless this habit be soon broken, the case may well be regarded as hopeless. A patient, for the relief of whose suffering cystotomy had been proposed, said that he had also been advised to urinate often so as to keep his bladder empty as long as possible. He therefore, for several months, employed most of his time in watching a clock, and whether or not he had any desire to urinate he did so regularly every fifteen minutes. It was very difficult to convince him that he was committing a grave error, but as he was daily getting worse he finally consented to pay no further attention to the minutes by the clock or watch, and in a few days retained his urine half an hour, three-quarters, and one hour, and in the course of three weeks the mechanical dilatation of the bladder was carried from sixty grammes to five times that amount. He was then able to retain his urine four hours. This urine, from being purulent, bloody, and offensive, became clear and normal."*

27. After the bladder has been dilated to the extent that it will receive at least a quarter liter of fluid without bleeding, and will retain the same amount of urine, if

* Phlegmasic affections of the urinary organs, p. 140.

then the urine be still purulent, silver nitrate in solution of one centigramme to sixty grammes of water may be advantageously used, and may be gradually increased to five centigrammes and ten centigrammes to sixty grammes of tepid water; injecting not more than one hundred and twenty grammes of the solution every three or four days until the urine becomes clear.

28. When cystitis and contracture have been caused by a stone or by a foreign body, and lithotripsy or the extraction of the foreign body is effected, it is absolutely necessary that a thorough after-treatment be instituted, for neglect of the bladder, particularly after lithotripsy, is fatal to this organ, and recurrence of stone, this time phosphatic, is almost certain. Very soon after either operation, the bladder should be daily emptied and irrigated, and the process of gradual dilatation begun and carried to the proper degree. The same precaution should be taken after any of the modes of treatment of narrow urethral strictures of long standing, and also in cases of vesical contracture from other causes.

29. In the majority of cases of permanent contracture limited to the vesical neck and causing stagnation and decomposition of the urine in the lower fundus, it is justifiable to resort to Mercier's method of internal incision or to external incision, as a means of remedying the trouble.

30. Early attention to the cystitis in cases of enlarged prostate will generally prevent diminution of the bladder capacity, but this attention must be unremitting. In some cases it is necessary to irrigate the bladder once or even twice daily; beginning with thirty or sixty grammes and increasing the amount of fluid at each injection, until

it reaches a quarter of a liter or more. At first the gain may be scarcely perceptible. In a week's time it may not exceed a few grammes, but afterward it is greater, and when the maximum is attained it must be maintained. However, the largest quantity need then be used but once every four or five days. When the bladder capacity is already great, it is only necessary to keep the interior clean by a moderate irrigation once each day.

31. There are some very exceptional cases of cystitis with contracture that cannot tolerate artificial vesical dilatation or even catheterism despite the free administration of belladonna, hyoscyamia, etc. Such sufferers require the most delicate management with the greatest amount of moral suasion. A remarkable case of this sort, a nervous and very sensitive man thirty-five years of age, under the writer's care for cystitis with exquisitely painful spasmodic contracture, was finally relieved by being persuaded to restrain his urgent and frequent desires to urinate; first, by abstaining from micturition for a single minute, then for two, three, five, and ten minutes after each almost intolerable desire to be rid of the offending urine. This was indeed a very sore trial to him but, gaining steadily, he persisted in the practice for nearly a year, when instead of urinating as before every ten or fifteen minutes, he was able to retain his urine over an hour. He then began to make very free use of diluent drinks, and in a few months the retentive power of the bladder had increased to nearly half a liter. Ever since that time the urine has been retained five and six hours without discomfort.

XXIII

BLADDER HÆMORRHAGE; ITS CAUSES, EFFECTS AND TREATMENT

1. Abundant hæmorrhage from the mucous membrane of the bladder though not of very frequent occurrence is nevertheless worthy of special attention. This particular loss of blood should be designated cysto-hæmorrhagia in preference to hæmaturia with its only meaning of bloody urine which may come from the kidney or from its pelvis, from the ureter, or from the urethra, as well as from the bladder. Cysto-hæmorrhagia may occur as a consequence of disease, of injury, or of the too precipitate evacuation of an over-distended bladder. It is chiefly the last-named cause and its effects that will here be discussed.

2. Civiale regarded over-distension of the bladder as "the most common of all the causes of hæmaturia"; the excellent observer saying that "when hæmaturia depends upon over-distension of the bladder by the accumulation of urine or by a forced injection, the blood seems to ooze indistinctly from every part of the mucous surface."* But he does not explain the mechanism of this general oozing. Nor does Mercier and his contemporaries appear to have solved the problem. The later examination of the question has led to the inevitable belief that, generally, there is no hæmorrhage so long as

* Maladies des organes génito-urinaires. Vol. iii, p. 360.

the bladder remains distended; but that the moment distension ceases, either by the bursting of this viscus or by the precipitate withdrawal of the urine through a catheter, the oozing begins, and that this oozing is due to rupture of many thousands of the capillary vessels of the mucous membrane, owing to a sudden change in their condition; for, in such over-distension of the bladder, the mucous membrane as well as the muscular coat is greatly over-stretched and its capillaries are likewise stretched and weakened. When, therefore, the mechanical support given by the accumulated urine is suddenly removed, the extreme tension of the vesical parieties is succeeded by extreme flaccidity; the almost empty capillaries are instantly gorged with blood, and their delicate walls give way before the sudden impulse of the refluent blood which soon begins to ooze from thousands of minute rents of the mucous membrane, the interstices of whose connective tissue are also filled with extravasated blood; nearly the whole internal vesical surface being in a state of ecchymosis.

3. It is well known that free hæmorrhage often succeeds the escape of pus from large, tense abscesses that have been hastily emptied; and this phenomenon has been correctly attributed to the too sudden removal of the pressure exerted by the accumulated pus upon the small blood vessels which lie almost naked on the wall of the abscess. This being true here, why not so in the case of a diseased bladder? The analogy is perhaps greater in those cases where hæmorrhage has occurred from the surface of smooth membranes, such as that of the tunica vaginalis after the sudden evacuation of large hydroceles, or of that of cysts of inordinate capacity

which have been incised or tapped. The general oozing of blood which sometimes occurs from the surface of a diseased peritoneum after ovariotomy furnishes another illustration.

4. Horace Stapfer, in his thesis on vesical "hæmaturia" caused by tuberculisation,* credited Civiale with being the first to cal attention to retention of urine as a cause of "hæmaturia," but said that "Civiale does not explain the mechanism of 'hæmaturia' caused by retention of urine" . . . and asked: "could it not be attributed to the sudden disparition of the pressure which the urine exerted upon the parieties of the bladder similarly to the phenomenon observed after puncture of certain cysts of the thyroid body?"

5. That hæmorrhage does not invariably follow the precipitate evacuation of the over-distended bladder is shown in the reports of cases where a great quantity of urine has been suddenly drawn off, as three, four, six, or nine pints, and in one case two gallons, with no consequent loss of blood. But much bleeding does occur in the vast majorities of cases after this sudden outflow of urine through the catheter, especially when the distended bladder is not in sound condition, as in the case of elderly men, with prostatic enlargement, whose blood vessels are weakened. Bladder hæmorrhage, from overdistension, is very uncommon in young adults and adolescents, and is of extreme rarity in children.

6. The foregoing account of the occurrence of hæmorrhage due to the sudden evacuation of the over-distended bladder refers more particularly to bladders that are not very much altered by disease; but it has also been shown

* Paris, 1874, pp. 8, 9.

that bleeding does occur in certain diseased bladders at the moment of distension by the urine or by a forced injection; the first few ounces of the urine or of the injected liquid drawn off being bloody, whereas, in the class of cases before mentioned the first urine that escapes is clear and entirely free from blood which does not appear until the next catheterism, and then it is abundant. In several such cases which Civiale recorded, he only incidentally said that the first urine expelled was always clear and that blood did not appear until the next time the bladder was emptied. It is evident, in those cases, that the blood had begun to ooze only after the removal of the pressure exerted upon the capillaries by the accumulated urine. Mercier * made a statement which is corroborative of this view, saying that "often two-thirds or three-fourths of the urine contained in the bladder came out free from blood, and it was only toward the end that the fluid appeared redder and redder," and further said that "this appearance had been wrongly ascribed to the precipitation of the blood in the basfond." He attributed the hæmorrhage to the action of the muscular coat of the bladder which, he said, "squeezes the blood out of the congested mucous membrane like water squeezed out of a sponge." Unfortunately for this theory and for sufferers, the very reverse of contraction too frequently follows the sudden evacuation of the over-distended bladder. If powerful contraction could always follow the precipitate artificial evacuation of the distended and disabled bladder, there

* "Recherches anatomiques, pathologiques et thérapeutiques sur les maladies des organes urinaires et génitaux considérées spécialement chez les hommes agés. Paris, 1844, p. 141."

would be no hæmorrhage, or if any occurred it would soon cease in consequence of this fortuitous contraction of the muscular coat, and of retraction of the mucous membrane, and of its underlying connective tissue.

7. However, hæmorrhage does occur without any great vesical distension, and by a different mechanism from that which belongs to the action of the column of blood upon the capillaries when the supporting hydraulic cushion is suddenly removed by the free escape of the urine. This is exemplified in cases of chronic cystitis with contracture of the muscular coat, general sclerosis of the other coats and diminished vesical capacity, when retention of urine or the forced injection of water can cause no distension without cracking or tearing the unyielding mucous membrane and causing a hæmorrhage which is made manifest at the first drawing of the urine or of the injected fluid. Hæmorrhage, even without distension from accumulation of urine, occurs in other diseased conditions of the bladder, such as villous growths, or tubercular, or cancerous degeneration, etc.

8. For diagnostic purposes, the main point is to determine whether or not the hæmorrhage be cystic, for the bladder may fill with blood which has come from another source. For instance, there may be free bleeding from the kidney due to a laceration of this organ, to a highly vascular cancer which has involved its pelvis, to tubercular disease; or the hæmorrhage may be owing to extreme renal congestion, as that occurring after the ingestion of certain poisons, among which may be noted phenic acid; or from prolonged exposure to the fumes of turpentine on turpentine ships or in shops. The writer has had under observation two cases of such

hæmaturia. Both men were workers in a varnish factory, and for several weeks had been passing bloody urine. They were advised to quit the place, and after a short absence from the shop they were well and the urine had become clear. The writer's attention was first called to this action of the fumes of turpentine many years ago by the eminent anatomist and surgeon Charles E. Isaacs, while he had in preparation his admirable paper on the minute anatomy of the kidney.

9. The occurrence of an abundant and continuous hæmaturia forbodes cancerous disease, and the unfavorable prognosis is soon verified at the necropsy. But when the hæmaturia is caused by certain parasites, such as the dystoma hæmatobium, its true nature may long remain obscure until it is revealed by microscopic examination of the urine. In other classes of cases the diagnosis is generally easy, as in the following, which is typical of the hæmaturia due to hyperlithuria: An elderly man, over fond of the pleasures of the table, after drinking even one glass of sparkling champagne wine almost always on the very next day began to suffer the pangs of renal colic followed by a hæmaturia sometimes lasting several days during which he could collect from the very bloody urine fifty or sixty round uric acid calculi the largest of which scarcely exceeded in size an ordinary pin's head. In some cases the hæmorrhage is from the ureter and is caused by a rough calculus during its transit from the renal pelvis to the bladder. The urine passed by such a sufferer often contains leech-like clots which clearly indicate the source of the hæmorrhage. Then again the bleeding may be from a much graver

cause. In a case of intermittent but profuse hæmaturia, the source of the hæmorrhage was determined from these circumstances, namely: the first was, that no retention of urine had occurred; the second, that the urine ordinarily contained at least two-thirds blood; the third, that it was, at times, perfectly clear; the fourth, that the hæmorrhage would, almost invariably, be preceded by a very distressing pyelic and ureteric colic on the right side; and the fifth, that the urine frequently contained firm, leech-like coagula five or six inches long. These facts, together with the existence of a tumor in the right flank, led to the conclusion that the hæmorrhage was ureteric and due either to a large impacted calculus or to malignant disease. The patient died in the course of a few months of great suffering, and the necropsy revealed a very vascular primary cancer of the right ureter, a little above its middle.

10. The bladder may be rapidly filled by blood coming from any one of the sources before named, but if this blood does not as rapidly coagulate it will be easily expelled through the catheter; and if its flow into the bladder be checked, as was shown in the case of ureteric cancer just mentioned there will follow pyelic and ureteric colic, and, while this lasts, the urine secreted on the sound side, at first tinged by the little blood remaining in the bladder, will come away clear, and so soon as the impacted clot is dislodged and carried into the bladder, the urine will be again bloody. During the ureteric colic the bladder may be syringed in order to wash out the remaining blood, and if the water afterward injected returns quite clear, it is then reasonable to suppose that the hæmorrhage is not cystic. But if the loss of blood

has been so abundant as to cause great distension of the bladder with clots, the case will be attended with a new danger if the bladder is suddenly emptied, for there will then be hæmorrhage also from its mucous membrane. When all the sources of hæmorrhage already indicated have been excluded, and the loss of blood is not from the urethra, then the vesical origin of the hæmorrhage is fairly established.

11. Profuse hæmorrhage is known to occur from ulceration of the bladder, from injuries of divers sorts, from perforation of small veins by parasites, from tubercular or from cancerous disease, or from villous growths. But it is the particular class of cases of which over-distension of the bladder is the predisposing and its sudden evacuation the exciting cause of hæmorrhage, that now claims special consideration.

12. The urine first drawn, with intent to empty the distended bladder, is usually clear and free from blood; at the second evacuative catheterism in the course of a few hours, it is blood-red; afterward it grows dark and dingy; but on the second day it is chocolate colored, and later assumes a tarry appearance and consistency, and acquires the disagreeable odor of decayed dried codfish. These changes in the character of the effused blood are due partly to the action of the urine, partly to the development of ammonia. In such case the bleeding, though abundant, is not always sufficient for the formation of coagula; for, so long as there is a fair proportion of urine, no coagulation takes place, but when the flow is rapid and greatly exceeds the urine in amount, the bladder is soon filled with clots, even to much over-distension. Such hæmorrhage may last from a few

hours to two or even three weeks, if not restrained by appropriate treatment.

13. The gravity of the constitutional effects depends upon the previous physical condition of the patient, the amount of daily loss of blood, and the extent and severity of the ensuing cystitis. By prompt and judicious interference the bleeding is soon arrested and the patient relieved of his distress. The danger to life is not so much from the severity of the hæmorrhage as from the extent of injury to the capillary vessels and mucous membrane. What is to be dreaded is the supervention of general cystitis which is so apt to be followed by double ureteritis and pyelo-nephritis. When these complications occur, there is oliguria, then anuria; all within a few days after the first catheterism that had given issue to three or four pints of clear urine.

14. The subjoined example of vesical hæmorrhage in an elderly man may be of practical interest. The writer was called in consultation to see Mr. S. B., sixty-three years of age, who had "for ten years suffered more or less from his bladder," and from occasional retention of urine. Ten days before the interview, which took place on an early evening of September, he had sat, for some time, upon the stone steps in front of his house, when, feeling chilly, he retired to bed. On the following morning he had some dysuria, and later complete retention of urine. His bladder having become painfully distended in the course of twenty-four hours, he summoned his physician who quickly relieved him of fifteen hundred grammes of clear urine. A second catheterism on the same day gave issue to bloody urine, and from that time all the urine drawn off was highly charged with blood.

When first seen by the writer, Mr. B was walking about in great agony from distension of the bladder though in the morning he had been catheterised successfully. Rectal exploration revealed a tumid, but not very large prostate, and a nearly rectangular metallic catheter, similar to Mercier's, encountered an easily surmounted median prostatic growth. Then the introduction of a soft rubber catheter gave issue to seven hundred and fifty grammes of fetid, alkaline, tarry fluid, consisting of about an equal amount of blood and urine, but the blood was well mixed with the urine. Inasmuch as the continuation of the hæmorrhage was due evidently to the frequent distension of the viscus it was suggested that its complete drainage be effected by the retention of the rubber catheter for at least twenty-four hours. An occasional vesical irrigation with about two ounces of weak tannin solution was also advised, likewise ice in the rectum, also absolute rest in the recumbent posture, and one gramme doses of quinine dissolved in diluted sulphuric acid. The attending physician had already prescribed one gramme doses of ergot extract and their continuance was advised. He had also irrigated the bladder with a salicylic acid solution with the effect of temporarily deodorising the urine. From the time the rubber catheter was introduced, no more urine was allowed to accumulate in the bladder, and the blood was frequently washed away with the styptic solutions. This course of treatment, together with constitutional medication, had the effect, within two days, of arresting the hæmorrhage and of controlling the existing cystitis. The patient made a good recovery, and his bladder was never again allowed to be over-distended.

15. The prevention of the kind of vesical hæmorrhage in question now claims some attention. If sufferers from prostatic and vesical affections were always under close medical observation, their bladders would not be permitted to become over-distended, and this predisposing cause of hæmorrhage from the mucous membrane would not exist. But since vesical over-distension too often occurs, it will be well to inquire into the ways by which relief may be given and hæmorrhage prevented. This can generally be accomplished in the following manner: The bladder is to be emptied very gradually in the course of twelve, twenty-four, or forty-eight hours, and in certain cases of extreme over-distension, even several days. One of the ways of effecting this is to introduce an India-rubber catheter and secure it in position, then to allow the urine to trickle out slowly by partly obstructing its distal orifice so that in the course of five minutes not more than two hundred and fifty grammes will have escaped, and to close the catheter, which is reopened as before in two hours, and so repeat the process every two hours until the bladder is finally emptied. If the urine drawn be very fetid, the process is to be modified as follows: Immediately after drawing the first two hundred and fifty grammes of urine, the same quantity of warm four per cent. boric acid solution should be thrown slowly into the bladder, then five hundred grammes of urine drawn off, and at once two hundred and fifty grammes of the boric acid solution injected. At the first sitting, this should be repeated six or eight times or until the whole of the offensive urine is gotten rid of and the bladder contains nothing but the clear boric acid solution; then, every two hours,

two hundred and fifty grammes of the fluid, now mixed with newly secreted urine, should be drawn out until the bladder is empty. In this way bland fluid will have been substituted for decomposed and irritating urine, the hydrostatic pressure will not have been removed too suddenly, and thus hæmorrhage will have been prevented.

16. Sometimes polyuria follows the first catheterism to such a degree as to make it necessary to draw off half instead of a quarter of a kilogramme of urine, and do this every hour instead of two hours; otherwise the vesical distension would be unrelieved. The brief history of such a case of inordinate polyuria without glycosuria may serve to illustrate this point. Mr. P. D., sixty years of age, stout, weighing about one hundred kilogrammes, suffering from prostatic enlargement and stone in the bladder, was sent to the writer by a medical friend. Mr. D., for a period of twenty years, at different times, had passed gravel and also well formed small uric acid calculi. He was subject to polyuria generally excited by almost all diuretics. He could never drink cider or ale, nor could he take copaiba or cubebs, without provoking great increase in the urinary secretion. For six consecutive weeks he passed nearly two liters of urine daily and during the next two weeks nearly three liters daily. At the end of that time his bladder became overdistended and the urine came out drop by drop. On that account he was catheterised by his family physician and one liter and a half of clear urine drawn in the first hour at intervals of twenty minutes. The catheter was kept in position and half a liter of urine drawn every hour for twenty-seven consecutive hours when the

amount began to diminish until it was reduced to three liters every twenty-four hours. At no time was there any hæmorrhage. In the course of three months the urine was reduced in quantity to two daily liters and so continued until the bladder was relieved of the irritation caused by several small stones which yielded readily to lithotripsy. After that operation, the quantity of urine passed daily did not exceed the normal kilo and a half.

17. In the treatment of vesical hæmorrhage, the first injunction should be absolute rest in the horizontal posture; then the physician should take means to prevent the bladder from again becoming distended. But if, when he arrives, he finds hypogastric dullness extending to or into the umbilical region, he should draw off, through a gum catheter, only half a liter of urine, then throw in a quarter of a liter of the boric acid solution mentioned in note 15, and draw a quarter of a liter of the bloody urine, and so repeat the process of injecting the quarter liter of solution and drawing a quarter of a liter of the urine until it becomes clear or nearly so; then every two hours the stopper of the catheter should be removed and a quarter of a liter of the nearly clear fluid allowed to flow until the bladder is completely empty. For that purpose the catheter should be retained in position twenty-four hours; very rarely longer. This mode of drainage alone will often have the effect of checking the hæmorrhage, especially if the muscular coat of the bladder soon begins to regain its contractility, which sometimes can be hastened by throwing in sixty or ninety grammes of cold watery solution of tannin, alum, or any other suitable astringent.

Ice in the rectum, applied according to Cazenave's plan, is a valuable adjuvant. The next indication is to guard against general acute cystitis, the supervention of which would be the most serious accident that could happen in such a case, except, of course, rupture of the bladder.

18. When hæmorrhage occurs in cases of cystitis with with sclerosis and diminished capacity, whether the distension of the organ be caused by retention of urine or by a forced injection, drainage through the retained catheter is essential; no urine should be allowed to accumulate, and hæmostatic irrigations in small quantities should be employed. The danger in such cases lies more in the aggravation of the cystitis than in the hæmorrhage itself, which ordinarily is not abundant.

19. The most serious hæmorrhages are those which come from villous or from cancerous tumors. In such cases the loss of blood is sometimes so continuous and so great as to prove fatal in the course of a very few days.

20. Although so great an authority as Civiale seemed to attach little importance to general treatment, it is nevertheless of the greatest aid in the management of bladder hæmorrhage and should not be neglected. Among the most efficient of the hæmostatics for internal administration are: ergotin in one gramme doses; quinine, in the same quantity, dissolved in dilute sulphuric acid; likewise gallic acid dissolved in glycerin; and tincture of the chloride of iron; any one of which answers the purpose. When the desired effect is obtained the medicine should be discontinued lest the digestive organs suffer. Reconstituents are generally much needed during the convalescence.

21. When, in bladder hæmorrhage, it happens that the catheter is blocked by clotted blood, it should be withdrawn and washed, or a clean instrument substituted. But when the bladder is filled with firm coagula, what should be done? In this there is a difference of opinion. Chopart advised the injection of warm water through the catheter to break up the clots, and with a syringe applied to the end of the catheter, the aspiration of the broken clots. He cited several cases so treated with success, and his method then and long afterward had no lack of advocates. Howship, Sir Benjamin Brodie, and other surgeons resorted to this procedure which they strongly recommended. Phillips cited Leroy as having extracted, a little more than two liters of coagula from a man's bladder, with the aid of aspiration made through a catheter which he was obliged to introduce one hundred and fifty times in the space of six hours.

22. Civiale approved of injections of warm water to soften the clots, as recommended by Verdier, but condemned aspiration. Other modern surgeons were also against aspiration of the clots, but their objections were scarcely tenable. The principal objection made was that the removal of the clots would excite fresh bleeding either by affording a cavity into which more blood might be poured, or by allowing the plugs to escape from the torn extremities of the capillaries. They also urged that the clots do no harm and are dissolved by the urine in the course of two days.

23. This misapprehension of the true state of things has led the opponents of aspiration to condemn its practice which had been so successful in the hands of

skilful surgeons. It is well known that these injections and aspirations properly done do not provoke fresh bleeding, and that it is the hasty removal of the bladder contents which excites hæmorrhage, the very thing the prudent operator seeks to avoid. Assuredly it is not good surgery to allow a bladder to become over-distended with blood and to wait forty-eight hours for the urine to dissolve the clots while the patient is in throes of vesical distension by whose ill consequences his life is threatened. In cases of profuse vesical hæmorrhage, the indications for immediate mechanical interference of the right sort are indeed of the plainest, and there surely will be no fresh bleeding if the vesical contents are not too hastily removed.

24. In endeavoring to free a bladder greatly distended with clotted blood, a good way to proceed is to introduce a Bigelow catheter of large caliber and slowly inject sixty or ninety grammes of diluted acetic acid (five per cent.) for the purpose of softening the clots; the instrument to be moved to and fro and rotated before aspiration is begun with the Bigelow aspirator. But no attempt should be made to draw off more than a quarter of a liter of clotted or grumous blood at a time, to be replaced by a quarter liter injection of a mildly acetous fluid or of a boric acid solution; care being taken to keep, as nearly as possible, intact the hydraulic cushion, consisting of blood, urine, and the fluid injected, for its sudden removal would be certain to promote a recurrence of hæmorrhage. At the same sitting, alternate injections and aspirations should be made until the return fluid is nearly clear. After this, every two hours, a part of the bladder contents, rarely more

than a quarter of a liter, should be drawn off until that viscus is empty. In the meantime, gallic acid or some other hæmostatic may be administered by mouth, and no urine should ever be allowed to accumulate in its reservoir. Such management is surely safer than the expectant plan of waiting until the clots are dissolved by the urine.

25. "When the coagula are not dissolved," said Paul of Ægina, "make an incision in the perinæum as in cases of calculus; and having removed the clots of blood, accomplish the cure in the proper manner." This operation of perineal cystotomy was revived by Larrey and performed by other surgeons of his time, in cases where the clots were too dense to be broken up by the catheter. This same operation in reported to have been practised, under the auspices of Sir Astley Cooper, by Mr. Copeland Hutchinson, with the result of extracting half a liter of coagula, but the patient died in three days. Civiale very properly condemns this heroic and ordinarily unjustifiable procedure, and suggests in its stead the employment of the lithotrite to break up the clots when so dense as to resist the action of the catheter. The writer had occasion, in such a case, to use the lithotrite with which the clots were so reduced as to be easily aspirated with Bigelow's apparatus, and obtained a successful result. The case may be worth rehearsing, particularly since it was the second time in the course of two years that the patient was attacked with vesical hæmorrhage from the same cause. He was a vigorous farmer, aged seventy years, and was seen in consultation on account of a more profuse hæmorrhage than that which had occurred nearly two years previously; his over-dis-

tended bladder having again been suddenly evacuated, five days before the writer was summoned. It was then filled with clots and distended up to the navel. Although there was a marked urethro-vesical obstruction due to enlargement of the prostate, catheterism was not difficult, but the catheter brought out no fluid because it was blocked by a blood clot. An endeavor was then made to break the clots by means of a large metallic catheter with unsatisfactory result, as only a little bloody fluid flowed. Recourse was had, at length, to a lithotrite which answered excellently to reduce the dense clots which were then easily aspirated through the largest of Bigelow's catheters. Following the aspirations free irrigations were made with diluted vinegar as pure acetic acid was not available in a farmhouse. After a rest of three hours the patient was in condition for further treatment, and it was easy to draw off some bloody urine free from clots by the employment of an ordinary soft catheter. Ten per cent. cold vinegar irrigations were afterward made with good effect and the hæmorrhage ceased within three days, after eight days' duration. The subsequent treatment consisted in periodic evacuative catheterism and antiseptic irrigations of the bladder. The cystitis was subsiding though the ensuing polyuria required the repetition of catheterism at least six times daily. The patient made a good recovery and was soon well able to attend to his duties.

XXIV

BLADDER SACCULATION; ITS DIAGNOSIS AND MANAGEMENT

1. In cases of chronic retention of urine, the bladder may be distended in any or every direction except at the trigone, which is its fixed point. In rare instances the increase in size of the organ is alone in its vertical direction. Mr. John Adams * has "known it to extend itself upward in its long axis, its fundus reaching the umbilicus, whilst in other directions it has remained nearly of its natural size." Civiale makes reference to a similar condition and records an illustrative case. The increase is usually most marked in the lower fundus which may be three times its normal capacity, so that when filled with urine it so impinges upon the rectum as to cause obstinate constipation. Vesical dilatation, even when there is no obstruction to urination, is not uncommon among elderly men. The writer has examined, post-mortem, several such bladders which were somewhat flattened antero-posteriorly, and much increased in transverse diameter, from right to left and little fore and aft, at the lower half of the organ. Adams and other surgeons make mention of similar cases occurring, however, in connection with prostatic obstruc-

* "On the anatomy and diseases of the prostate gland," London, 1851, p. 73.

tion. Among the wet preparations in the Army Medical Museum is an excellent illustration of the occasional great increase of the lower vesical fundus. In this case it was due partly to prostatic enlargement, partly to the lodgement of twelve large uric acid calculi. A photograph of the bladder and its contents, kindly sent by Dr. George A. Otis, surgeon U. S. Army, was accompanied by a printed description of which the following is a correct transcription:

"This specimen was taken from a private patient, a native of Frederick, Maryland, who died Aug. 3, 1857. Besides the twelve large concretions, the bladder contained numerous hemp-seed calculi, many of which were discharged during life. In 1849 more than three hundred were discharged through the fenestra of a very large catheter. The lobes of the prostate are much enlarged. On the right and middle lobes are several ulcers. The walls of the bladder are much thickened. The specimen measures as follows: From fundus to membranous portion of urethra, six inches; across fundus and body of bladder, in which the calculi are contained, four and one-eighth inches; from external wall of fundus to top of middle lobe, two inches and seven-sixteenths; thickness of the walls of bladder, seven-eighths of an inch; the width of the left lobe of enlarged prostate is one inch; that of the right lobe, two inches; the width of the divided and degenerated prostate is four inches and ten-sixteenths."

2. The several morbid conditions just named, interesting in themselves and most of them of common occurrence, do not constitute sacculation, but simply dilatation, of the bladder. They were described solely

for the purpose of drawing a sharp distinction between dilatation and true sacculation of the bladder.

3. By sacculation of the bladder is meant the protrusion of its mucous and sub-mucous coats between bands of muscular fibers so as to form sacks or herniæ of greater or lesser size constricted at their vesical orifices. This morbid condition is much more common in advanced life than in youth and middle age and is generally the consequence of obstructed urination. Nearly every writer on vesical and prostatic affections for the past hundred and fifty years has given examples of bladder sacculation. Among them may be named Heister, Parsons, Houstet, Chopart, Baillie, Everard Home, Wilson, Civiale, Gross, and others. But it was reserved for Dr. Mercier, of Paris, to interpret the phenomena of the more common form, which he began to study in the year 1835, and which he described in an able essay, published in the *Gazette Medicale*, 1836, under the title of *Mémoire sur certaines perforations spontanées de la vessie non décrites jusqu'à ce jour*. He was then a hospital interne.

4. Vesical sacculation occurs in two forms: (*a*) As a single pouch of from fifteen grammes to a quarter of a liter, or even of much greater capacity, or as multiple diverticula from three to six or more in number, sometimes communicating with each other; (*b*) As great numbers of small sacs containing from a few centigrammes to four grammes of urine, like so many herniæ of the mucous membrane thrust outwardly between columns of muscular bands.

5. Nearly all authors agree as to the nature of these vesical diverticula, which are the outcome of obstructed

urination from urethral stricture, stone in the bladder, or enlargement of the prostate. In these circumstances the bladder becomes distended with urine; frequent efforts are made to expel this retained urine and, as a consequence, the muscular coat is thickened; but this thickening, being unequal in many cases, leaves certain weak spaces between the muscular bands. In some of these morbid reticulations the mucous and submucous coats are gradually forced outward and in the course of time—months or years—a single diverticulum is formed, or a multitude of diverticula of variable sizes appear on the outside of the bladder. Civiale mentions a case in which there were so many sacs visible on the outside of the bladder that it resembled a bunch of grapes.* The size of the vesical pouches is in inverse ratio to their number. When very large there is one, sometimes three or four besides, but smaller. In rare instances very small sacs exist with one or two large pouches. These diverticula are liable to occur in any part of the bladder except in the trigone. The most common seat of the large sacs seems to be the side, right or left; next, the posterior and lower part; then the summit; and least of all, the anterior and lower part of the bladder.

6. In a carefully dissected specimen of bladder sacculation, there was on each side a diverticulum nearly globular in form, and having a circular vesical orifice with smooth edges, capable of admitting the index finger. The diverticulum of the left side was greater in size than the bladder, and that of the right side was equal in capacity to one-third of the bladder. There

* "Maladies des Organes Génito Urinaires," 1860. Vol. 3, p. 7.

were also three small diverticula which communicated with the largest at its lower and posterior part, and which were each equal to about fifteen grammes in capacity. Of the many other dissections of sacculated bladders since made by the writer, the large majority consisted of single sacs containing from fifteen to sixty grammes of fluid and seated in the sides of the organ; and in but a single case was the sac at the postero-inferior part of the bladder. This sac had a vesical orifice of thirteen millimeters in diameter, its edges were smooth, and it contained a stone of about two centimeters and five-tenths in mean diameter, whilst its capacity was one hundred and twenty grammes, or perhaps a little more.

7. As vesical diverticula increase in size, the mucous and peritoneal coats remain stationary in thickness, but the intervening layers of connective tissue increase in thickness proportionately to the augmenting size of the diverticulum; otherwise the sac would burst long before attaining the enormous size which some of them are reported to have reached.

8. A case recorded by Dr. Wm. Warren Greene,* of Maine, of which the following is an abstract, illustrates both the difficulty of diagnosis, and the enormous size which a vesical diverticulum may attain. Dr. Greene was called, on December 1, 1861, to see a man eighty-four years of age, who had been suffering from dysury for six or seven years, and who, during those years, had always been obliged to strain much at each act of urination. He had never been catheterised. The family physician's diagnosis was hydatids of the liver. The

* American Medical Times. Vol. 4, March, 1862, p. 177.

abdomen was much distended, tense, and dull under percussion. The right iliac region was prominent, fluctuating, and tender to pressure. Rectal exploration discovered enlargement of the prostate. Only four grammes of urine flowed through the catheter used for vesical exploration. Dr. Greene's diagnosis was encysted liquid with bi-section of the sac; but could not determine the exact nature or origin of the sac or of its contents. From the result of the catheterism he inferred that the cavity of the bladder was nearly obliterated by external pressure from the morbid swelling. Death occurred on the 11th of December. The necropsy revealed many firm adhesions of the peritonæum and walls of the cyst. The bladder was thickened and communicated with an immense diverticulum which filled the rest of the abdominal cavity, crowding the liver and stomach completely out of sight. This sac contained a little more than four liters of limpid urine. The thickening of the bladder was most marked in its posterior wall; the maximum thickness being three centimeters. The communication with the diverticulum was by an opening through the left side of the bladder ten centimeters from its neck. This opening was about four centimeters in diameter; its outline was regular and its edges were smooth. The walls of the pouch were made up of a prolongation of the mucous and peritoneal tunics of the bladder; the muscular coat being absent. The prostate was as large as a medium-sized orange.

9. The morbid appearances of a case of bladder sacculation in which no diagnosis had been made were reported by Dr. J. H. Hinton.* The patient was sixty-

* Medical Record, 1871. Vol. v, p. 546.

eight years of age, and had been suffering from dysury for five or six years. He had a protuberance, in the right iliac fossa, twenty centimeters in its longitudinal and ten centimeters in its transverse diameter. . . . . The bladder was bound down by adhesions. Communicating with its cavity were five diverticula which, collectively, made up the tumor noticed in the right iliac region. The prostate was much enlarged. The bladder contained two liters of urine. The pelvis of the left kidney was enormously dilated, as was also the ureter.

10. Heister saw a bladder with three sacs, one at the upper fundus and one at each side, besides many others, smaller and scattered throughout the organ. And Platner examined a case in which there were thirty-nine sacs, each containing a calculus.

11. During the operation of lithotomy upon a child, the writer found a large stone chatoned in the anterior vesical wall and was obliged to tear the edge of the sac and so widen its orifice before he could seize and extract the stone. In another case—an adult patient—he found a stone, of four centimeters in diameter, in a sac at the posterior wall of the bladder, and, before its extraction could be effected, it was necessary to enlarge the orifice of the sac. Both patients recovered speedily.

12. The following, published by Dr. Charles D. Smith,* is given, in abstract, as an example of a diverticulum at the summit of the bladder. The patient was seventy-six years of age, and for five or six years had been suffering from prostatic obstruction. Urination was difficult, frequent, and painful. An intra-abdominal

* N. Y. Journ. of Med. New Series, 1853. Vol. x, p. 359.

tumor, conical in form, was discovered midway between the umbilicus and pubis. Its apex was movable from side to side, more to the left; its base was fixed. The tumor was elastic but painful when compressed. How long it had existed was not known and its true character was not ascertained. However, it was believed to be, in some way, connected with the bladder, though it was of the same size after as before urination. The patient died about nine months after he was first seen by a surgeon. . . . The prostate was found greatly enlarged and obstructing the vesico-urethral outlet. The bladder was much thickened and contained about a liter of urine. At its summit, the mucous and sub-mucous coats had been pushed through between bands of the muscular coat and had formed a pouch or cyst, of the "size of an egg," which constituted the apex of the tumor felt through the walls of the abdomen. The walls of this pouch were very thick, and its vesical orifice was narrow. The contained urine was putrid and very offensive in odor. The ureters and renal pelves were much dilated.

13. Vesical pouches, large or small, seldom completely empty themselves. Consequently the urine they contain is apt to become putrid and cause ulceration of their mucous membrane at one or several points. The ulcerative process may extend to and through the other coats and allow the putrid urine to be poured into the ambient connective tissue, giving rise to vast abscesses ending in fatal sapræmia, or the urine may make its way into the peritoneal cavity; death occurring suddenly from collapse, or in the course of a few days from septic peritonitis. Sometimes these pouches discharge

their contents into the rectum or the sigmoid flexure of the colon.

14. The second form of vesical pouches, briefly referred to in note 4, will now be further considered. This form of pouches, much more common than the first, is often overlooked, even on post-mortem inspection of the bladder; but once well understood can be easily discerned. The profession is indebted to Dr. Mercier for the description of these pouches and for calling attention to their frequent termination in perforation of the bladder. The following are substantially his views, as expressed in his paper of 1836.* The muscular coat of the bladder consists of bands of fibers which cross each other in various directions, leaving here and there vacant spaces or intervals occupied only by mucous membrane and connective tissue between the peritoneal coat and the interior of the bladder. When, owing to any obstacle, the bladder contracts to expel the urine which can not flow easily by the natural channel, its tendency is to escape where it finds the least resistance; therefore it is forced with the mucous membrane in these intervals between the muscular fibers; producing diverticula of varying sizes which are regarded as herniæ of the bladder. These appendices having no muscular coat are deprived of contractility and can not expel the urine which they contain and which is soon decomposed and causes inflammation, ulceration, and perforation of their parieties. The smallest of the sacs, which ordinarily are scattered on the sides, and even in the greater extent of the bladder, vary in depth from three millimeters to two centimeters. Their direction is often perpendicular to

* Mercier, loc. cit.

the mucous surface and as often oblique, and their vesical orifice is more or less rounded and averages in diameter that of a goose quill. Their lining mucous membrane is slightly thinner than, and continuous with, that of the bladder cavity. This lining mucous membrane is sometimes in direct contact with the peritonæum, but generally there is an intervening layer of connective tissue. It is particularly on the sides of the bladder above the ureteric orifices and at the postero-inferior part that these small sacs are observable. They occur, as do the other vesical pouches, in individuals affected with prolonged dysury who often make very strong efforts to urinate. In time, the mucous membrane of some of the alveoli becomes eroded, bursts during an effort to expel the urine, and allows its foul contents to escape in the surrounding tissues. Frequent as is this occurrence, Dr. Mercier, in 1835, had nowhere found an exact description of the morbid condition from which it arises. He declared that the perforations had always been confounded with those produced by the prolonged retention of catheters in the bladder. Any doubts that may have occurred to others were cleared when, in 1836, appeared his paper in which he recorded the post-mortem appearances of the bladder and surrounding parts, in nine cases of recent spontaneous perforation of vesical alveoli.

15. While making the post-mortem inspection of an elderly man, who for several years had suffered from dysury due to prostatic obstruction and to the presence of a vesical stone, and had succumbed to septic pelvic peritonitis, the writer found recent adhesions beween the posterior part of the bladder and the rectum; on

tearing which a quantity of fetid pus escaped, revealing a cavity of considerable size. This abscess cavity was in communication with a small diverticulum on the left side of the lower fundus of the bladder There were besides this several other alveoli in and near the fundus. Although the immediate cause of death was sapræmia incited by the leakage of putrid urine n the connective tissue spaces, the kidneys were in such an advanced state of disease that the patient could not have lived very much longer. In another case there were, on the right side of the lower fundus, two peri-cystic abscesses due to the perforation of small diverticula.

16. The diagnosis of vesical pouches of the first form is often very difficult, and, in many instances of large sacs, is never made. The cases related in notes 8, 9, 12, and the subjoined case are fair examples of failure in their diagnosis. These pouches have been mistaken for divers other diseases, and have been treated expectantly or have been punctured, under the supposition that they were serous cysts or abscesses. A case reported by Professor Alonzo Clark * is a fair illustration of some of the errors in diagnosis and in treatment to which vesical pouches sometimes lead. The doctor said that if the patient had been of the gentler sex he would have regarded the tumor as an ovarian cyst.

17. The following is an abstract of Professor Clark's case. The patient was sixty-eight years of age and had been ill for three years, during which time he was steadily losing flesh and strength. The physical examination revealed an intra-abdominal tumor on the left side, extending from the lumbar region to the pelvis. This

*N. Y. Journal of Medicine. Vol. iii, Third Series, 1857, pp. 86–90.

tumor was thought to be a serous cyst of the kidney with a capacity of six liters or more. The question of puncturing it arose but Dr. Clark did not think such a measure expedient inasmuch as there was a doubt in regard to its true nature. However, the attending physician did tap it and withdrew three and a half liters of fluid.* After this, the patient was not able to urinate, whilst before he had done so without much trouble. The physician then introduced a catheter and drew off four liters of bloody urine from the bladder. The catheterism was repeated daily until the patient's death, ten days after the tapping of the cyst with a trocar. At the necropsy the bladder was found to be largely distended with urine. Its muscular coat was enormously thickened. . . . Attached to the left side of this bladder, communicating with it by a rounded opening about two centimeters and a half in diameter, was a cyst, resembling an ovarian sac, which would hold four liters or more. The tumor extended from the pelvis upward into the lumbar region above the kidney, crowding the intestines into the left hypocondriac region, and displacing the spleen. The sac, though not full, contained from three to four liters of bloody fluid. It was adherent, in nearly all its lower half, to the walls of the abdomen. The puncture made for tapping was above the adhesion and seemed to be in a nest of blood-vessels. There was no extravasation of the contents of the cyst into the peritoneal cavity. The prostate was much enlarged in the central portion; causing an urethro-vesical barrier which had impeded urination. The kidneys were in consequence much diseased, especially the left whose

* It does not appear that this fluid was analyzed.

pelvis was much dilated, the left ureter was likewise dilated.

18. In a doubtful case like the above named, the diagnosis may be cleared by aspirating thirty or forty cubic centimeters of fluid from the sac and subjecting this fluid to chemical analysis, and its sediment to microscopic examination. There are, however, certain symptoms which, when rightly interpreted, are likely to lead to a correct diagnosis. When the surgeon is called upon to treat a patient who, for any considerable length of time, has been suffering from dysury due to urethral stricture, stone in the bladder, or prostatic enlargement, he should think of the possible existence of vesical sacs, since obstructed urination is the principal and essential factor in the production of this morbid condition. If then, in such a case, he find a fluctuating hypogastric or iliac tumor, more or less tender to pressure, he should proceed to examine the bladder with a catheter by means of which not more than half a liter of urine should be drawn off, for he should be especially careful not to empty the bladder and thus avoid exciting a troublesome hæmorrhage from its mucous membrane and from that part of the cyst. If, in the course of a few minutes after this process, the abdominal tumor, tense before, should collapse and diminish in size, the strong inference would be that the cyst was in communication with the bladder and that it could be nothing else than a vesical diverticulum. But in case there should be no abdominal or iliac tumor the presumption would be that the cyst was not of large size or that there might be several small sacs, not discernible until the emptying of the distended bladder in accordance with the directions given in note

15, Bladder Hæmorrhage. Then if in a few minutes, after the last catheterism, a quarter liter or less of urine should be drawn off, it would be fair to conclude that this urine had come from a vesical diverticulum or from several smaller sacs whose capacity could be only approximately determined, though the situation of the sacs be not absolutely indicated.

19. Guthrie suggested, as a diagnostic sign of vesical sacculation, what he called the "fluttering blow" of the bladder; a sensation, he says, which is felt by the surgeon while he is drawing off the urine by means of a catheter, the end of the instrument being struck several times convulsively by the flapping emptied sac. This sign is by no means trustworthy as diagnostic of bladder sacculation and should be rejected. Fluttering blows certainly occur but do not necessarily indicate sacculation, for the walls of the sac contain no muscular tissue. This convulsive action is almost daily observed by those who frequently catheterise patients whose bladders are not sacculated. In almost every case of irritable bladder, fluttering blows occur at the close of or even during urination through the catheter and sometimes give much pain to the patient, besides often misleading the surgeon to suspect the presence of a calculus.

20. In the case of the small diverticula described by Mercier, the symptoms are generally so obscure as to render an accurate diagnosis extremely difficult. The supervention of peritonitis from perforation of the sacs is too often the only indication of their existence. A columnar bladder presumably contains such alveoli, and the columns can be felt by means of a rectangular sound or catheter, so that in this case the surgeon may

look for the little sacs. In these days the diagnosis would be made with certainty through the aid of the cystoscope.

21. The prognosis is generally somewhat unfavorable, to say the least, in the case of very large diverticula; doubtful in that of the alveoli described by Mercier; and hopeful in a fair proportion of cases of sacs containing stones.

22. On prevention a word must be said before pointing out the chief means of treatment likely, if not to cure, at least to mitigate suffering and to retard the process of enlargement of the cyst. Having in view the primary cause of vesical sacculation, which is obstruction to urination, the first preventive measure should be the removal of the obstruction, as the restoration of the urethral caliber in case of stricture; the extraction of a stone if the presence of a stone be the cause of obstruction; the incision of the urethro-vesical orifice if its permanent contracture be the cause; or the enucleation of the whole prostate if its increase be the cause of obstruction; or at least systematic evacuative catheterism if such cutting operations be contra-indicated. When obstruction to urination has already led to cystitis and dysury, not only should the offending stagnant urine be withdrawn several times daily, but the cystitis treated by appropriate irrigations and by the exhibition of suitable internal medicines. If a patient who has suffered from dysury only a short time be so treated, he will probably never have sacculation of the bladder.

23. In the treatment of a bladder that has become sacculated the surgeon should use his best endeavors to check the progress of the disease. The prime indication is that which was pointed out as the first pre-

ventive measure, that is to say, the removal of the cause of obstruction to urination, or if this is not possible, or if contra-indicated, to employ artificial means for the bladder's evacuation. But besides emptying the bladder and the diverticulum, frequent irrigations should be used. If the bladder and sac are largely distended, they should never be precipitately emptied, owing to the liability of the occurrence of profuse hæmorrhage as soon as the cushion of urine is removed from the overstretched walls of the bladder and of the diverticulum. Dr. Clark's case is a striking example of this evil, resulting as it did from suddenly withdrawing a large quantity of fluid from the distended sac and bladder. In such cases the surgeon should not draw off from the bladder more than half a liter of urine at a time. Then he should throw in a quarter liter of warm solution of boric acid, and repeat the process of drawing a half liter of urine and substituting a quarter liter of the solution, at the same sitting, until the bladder and sac are relieved of purulent urine and contain little if anything more than the solution, and are at the same time less distended. A broad bandage should then be applied to the abdomen to make suitable compression of the sac. After having gradually emptied the bladder and cyst in the course of a week or ten days, the irrigating process should be continued indefinitely to keep both as free from pus as possible. It can scarcely be hoped to accomplish more than to cause a slight diminution in the sac's capacity and relief of the existing cystitis. Hence the necessity of the frequent evacuative catheterisms and bladder irrigations. The long standing hydraulic pressure upon the kidneys being thus slowly and

gradually relieved, the life of the patient may be prolonged several months or even as many years, and his suffering greatly relieved.

24. It is extremely dangerous and therefore very unwise to tap a much distended diverticulum of the bladder either with an ordinary trocar or with a hollow needle followed by pneumatic aspiration of its contents. A correct appreciation can be formed of the ill effects of such a rash measure by considering for a moment what are likely to be the consequences of the sudden evacuation of any over-distended sac lined by a mucous membrane. There is no need of further comments on this subject, since a case illustrative of the evil of tapping a large vesical diverticulum has already been cited.

25. It has been proposed to puncture small sacs through the abdominal walls and also through the rectum. The hazards of such a procedure, in either case, far overweigh its pretended advantages which may well be questioned.

26. Among the details of treatment it may be mentioned that in endeavoring to free the sac or sacs from purulent urine it is sometimes necessary to change the position of the patient from the right to the left and from the supine to the prone. No compression of the cyst should be made while it is in a state of distension. It is only after it has discharged a considerable part of its contents into the bladder that its compression by an abdominal bandage is safe and serviceable. The catheter should not be left long in the bladder, but introduced at regular intervals to keep this viscus empty and the sac from distension, and one daily irrigation of the bladder will then suffice for its disinfection.

27. The treatment in the case of the alveoli described by Mercier is practically the same as in that of large sacs, but care must be taken to avoid throwing in a large amount of fluid at a time. Sixty or ninety grammes slowly injected and at once allowed to run out of the catheter, repeating the process four or five times at each sitting, will suffice to wash away the purulent urine contained in the little sacs, and thus prevent erosion of their mucous membrane.

28. Radical treatment is applicable only to diverticula that have not attained the great dimensions reached by some of the cases described in the preceding notes, and is absolutely contra-indicated when the kidneys have become infected or are otherwise seriously diseased. When, through the cystoscope, the orifice of a diverticulum is discovered and its exact site ascertained, the surgeon, with reasonable hope of success, may undertake the disinfection of the bladder and the extirpation of the diverticulum; closing the vesical wound so securely as to prevent leakage of urine, and using syphonage by means of a long rubber catheter passed through the urethra, to hinder its accumulation during the process of cicatrisation; or at least very frequent evacuating catheterism. Diverticula of the summit and posterior wall of the bladder may be reached by a median incision whilst those of the sides will require lateral section of the abdominal walls. Such an undertaking is warranted by the great achievements of the modern surgery of abdominal organs, and by the excellent results of suture of the bladder in cases of rupture or of incised wounds of this organ, and of its suture after epicystotomy or after excision of parts of its walls.

XXV

BLADDER STONES; THEIR DIAGNOSIS AND INDICATIONS FOR REMEDIAL MEANS

1. The notations on the diagnosis and indications of treatment of bladder stones need to be premised by a few words relating to the origin as well as the prevention of urinary calculi.

2. Some of these concretions are known to be of diathetic and others of purely local origin. Those of diathetic origin are generally preceded by persistent hyperlithuria which excites, in the renal pelvis, a sufficient flow of mucoid substance to cement together many crystals of uric acid or of other urinary salts in the form of small, irregular, more or less rugous masses whose propulsion through the ureter gives rise to dull and sometimes to very severe pains styled ureteric colic, and whose impaction in that tube causes a nephritic colic due to the consequently dammed up urine distending the pelvis of the kidney, and which is known to the laity as kidney colic. When such a gravelly mass reaches the bladder it ordinarily forms the nucleus of a constantly increasing vesical stone, unless it should fortuitously be expelled. In very rare instances the nucleus of such stones is a small clot of blood.

3. The vesical concretions of local origin occur from the agglomeration of phosphatic salts that are so abundant in the stagnant decomposed urine in certain cases

of chronic cystitis, or from the presence of foreign bodies, and increase in size with very great rapidity. The concretions of diathetic origin vary from a few centigrammes in weight to many hundred grammes. One of the heaviest and largest of the sort was removed through a perineal cut by Valentine Mott. Some of those of local origin have attained much greater dimensions and weight notably one weighing about a kilogramme was extracted supra-pubicly by Uytterhoeven, of Brussels, and another which filled the bladder and weighed forty-four ounces was removed through a perineal lithotomy by Sir James Earle. All these patients died soon after the operation. Mention is made by Eve,* of a calculus, weighing fifty-one ounces, extracted after death.

4. The preventive treatment in cases of hyperlithuria embraces hygienic and medicinal means. The needed hygienic observances comprise diet, exercise, ablutions, and raiments. The medicinal means of prevention are directed against gastric and intestinal disturbances and hepatic inaction. Chemical means of prevention are applicable solely to cases of phosphatic gravel due to stagnation and decomposition of the urine, or to injuries of, or foreign bodies in, the bladder, and mechanical means are employed against uric acid and phosphatic gravel as well as against foreign bodies.

5. Hyperlithuria, often being the outcome of neglect in the observance of hygienic precautions, is successfully combatted only by their rigid enforcement. A simple but varied diet suitable in quality and moderate in quantity, for the hyperlithuric sufferer is too often a careless and large feeder or a chronic dyspeptic; free

* Remarkable cases in surgery.

open-air exercise "to burn uric acid," as semi-facetiously said a too sedentary physician who had realised the importance of greater muscular activity; abundant intestinal douches; frequent external ablutions followed by brisk friction to stimulate cutaneous blood-circulation; copious internal watery ablutions to flush and cleanse the kidneys; abstention from sweet wines; light underclothing in warm weather and heavy woolen garments in winter; are the main hygienic means which are helpful in the prevention of accumulation of gravel.

6. Medicinal treatment is applicable to cases of persistent hyperlithuria and nephralgia, but is of no avail as a dissolvent of even very small vesical calculi. It has long been supposed, chiefly by the laity, deceived by the advertisements of charlatans, that alkalies, taken by mouth and excreted by the kidneys, act chemically upon uric acid vesical stones, forming soluble salts and so disintegrating these stones. Alkalies taken by mouth do not disintegrate but rather, as said Denamiel, disgregate the calculous particles by acting upon their mucous cement and thus rendering these stones inordinately friable. But to effect this disgregation the necessary free dosage and long continuance of these alkalies cannot fail to be harmful to the patient. In persistent hyperlithuria, the use of largely diluted salts of soda or potash in moderate dosage for two or three weeks ordinarily fulfils the indication of converting uric acid into harmless urates and of thus preventing the formation of stone, besides relieving the irritation caused by the sharp pointed crystals. The longer continuance of alkalies in any form whatsoever only

serves to disturb digestion and increase the uric acid which is the most common kind of gravel.

7. The local chemical means of prevention are applicable only to phosphatic concretions originating in the bladder. The agents once proposed for the disintegration and dissolution of other than phosphatic calculi were of such a nature as to destroy the vesical coats before fairly acting on the stones, and this visionary notion was soon abandoned. Then, for litholysis of phosphatic gravel, vesical irrigations with warm water acidulated with half of one per cent. of hydrochloric acid were used, but without giving entire satisfaction, and this mode of treatment had but few advocates. The profession is now much indebted to Dr. Hoskins, of Guernsey, for the discovery of the safe and efficient process of litholysis of phosphatic gravel which consists of daily vesical irrigations with a solution of lead acetate and acetic acid from three to four parts of each to one thousand parts of warm water. The effect is a prompt double decomposition resulting in the formation of a milky fluid composed of a suspended insoluble phosphate of lead and a soluble acetate of the bases. This treatment, whose length depends upon the size of the concretions, is specially useful in the case of the phosphatic stones that occur so frequently in prostatic obstruction to urination, and has often obviated the repetition of lithotomy or of lithotrity, besides being valuable as after-treatment of lithotrity for phosphatic calculi. It is also peculiarly effective in those almost unmanageable cases of phosphatic gravel due to stagnant, alkaline, slimy urine.

8. The mechanical means of prevention of vesical

calculi consist in the timely aspiration of fine gravel of any sort; in promoting lithecboly soon after an attack of nephritic colic; in resorting to lithexæresy in the event of failure of lithecboly; in the speedy removal by aspiration of slimy urine laden with phosphatic crystals; and in the prompt extraction of foreign bodies.

9. The aspiration of vesical gravel is effected by the introduction of a large-eyed catheter, through which is drawn this gravel by means of any of the India-rubber aspirators now in use. Lithecboly is promoted by the copious imbibition of mild diuretics and by the free dilatation of the urethra to the extent of permitting the spontaneous casting out of a calculus measuring from eight to ten millimeters in mean diameter.

10. The passing of a calculus from the renal pelvis to the bladder is often attended with the most excruciating spasmodic labor-like pains which cease the moment of delivery of the stone into the bladder. These pains of ureteric and nephritic colic may last but a few hours or the travail may continue two or three days or even a much longer time. One of the writer's patients, despite active treatment, suffered intermittently from severe ureteric spasms for a period of three months before the stone made its way from the left kidney to the bladder, and had the good fortune of expelling it on the day of its entrance into the bladder.

11. The treatment of a sufferer from nephritic and ureteric colic is directed toward allaying the violent spasms of the smooth muscle tissue of the ureter and at the same time to render the patient as insensible to pain as may be justifiable, and thus allow a steadier descent of the calculus. For these ends, a few doses of two

grammes of chloroform may each be taken in fifteen grammes of thick syrup washed down by a drink of water. In the majority of instances this measure is very quickly effective, but in case of its failure, hypodermatic injections of morphia and atropia combined, given in sufficient dosage, at reasonable intervals, become necessary. These means are supplemented by large enemata employed to rid the intestines of gases and accumulated feces, and by hot fomentations to the abdomen or by dry heat if preferred. The sudden cessation of pain indicating the delivery of the ureter and the entrance of the calculus in the vesical cavity, copious diluent drinks are prescribed with intent to flush the kidneys and so favor the propulsion from the bladder and the final escape of the calculous mass by the ensuing great flood of urine. Sometimes, however, the calculus becomes impacted in the urethra and causes painful retention of urine. It is then time to resort to lithexæresis by the use of the alligator-jawed forceps or of the urethral lithotrite.

12. When it happens, as it so frequently does, that the stone, while still very small, is not cast out of the bladder, it increases in size from month to month by successive layers of calculous material and causes more or less distress. Some patients suffer comparatively little inconvenience and have but slight manifestations of the local trouble, such as obscure dull aches, even in distant parts. Luxmoor, as early as 1809, called attention to the occurrence of neuroses of the lower extremities as occasionally symptomatic of urethral stricture, and other surgeons have noted the same symptoms in cases of bladder stone and of other affections of the pelvic

organs. Brodie mentioned the case of a calculous patient who had no symptom of the disease save a neurosis of his left lower extremity, chiefly at the heel. This only symptom vanished soon after extraction of the stone. Other patients are tortured by a constant desire to urinate attended with agonising vesical spasms, and some of these sufferers manifest extraordinary endurance of their grave infirmity. Amongst the great and good men who have borne with unexampled courage and patience the pangs of stone in the bladder may be cited the illustrious Greek philosopher Epicurus, whose sufferings from this disease were in the extremest degree, but who, without having suspended his labors, bore his ails with patience and passed away in intense agony; and the great English physician Sydenham, who, unrelieved of his misery, died peacefully without ever having made the least plaint of his unceasing distress, and who, almost up to the last moments of life, continued his medical researches. Such instances are indeed very rare in our days, when the promptest relief comes from lithotomy so little performed anciently, and so uncommon even in the time of Sydenham; or from modern lithotrity as employed in the early period of the affection.

13. Palliative treatment of chronic lithiasis is indicated in the case of patients who are exhausted by some intercurrent grave disease or serious involvement of the upper urinary organs caused by the presence of a vesical stone which cannot be removed with safety; and comprises medicinal and mechanical means designed to mitigate pain and prolong life. In such a case restoratives, cordials, mild stimulants, milk and other simple

but nourishing and easily digested food, are needed to husband the little strength left to the sufferer. The teasing spasms of the bladder are relieved in fair measure by the judicious employment of belladonna or its alkaloid, and the pain assuaged by the prudent use of opiates or other hypnotics. Much comfort is given the patient by cleansing his bladder with mucilaginous decoctions and with the acetic acid and lead acetate solution to which reference has already been made, as it counteracts the bad effects of the ammoniacal urine besides causing such decrease in the volume of the stone as to relieve suffering at least temporarily. Hip baths of not longer than five minutes duration and not too hot, fomentations or dry heat to the hypogastrium, and suitable posture in bed, frequently changing the hip pillows, are the chief adjuvants in the management of the case.

14. The main grave effects, immediate and remote, of the undisturbed presence of a stone in the adult bladder, are: more or less intense inflammation of the vesical mucous membrane, chiefly at the lower fundus and internal urethral orifice; more or less hæmorrhage from the mucous membrane; ulceration which sometimes extends through all the vesical coats and ends in perforation of the rectum or of the peritonæum; great thickening of all the bladder coats; increase of the inner muscular layer into bold columns; sacculation of the bladder; prostatitis when the calculus or a part thereof is engaged in the prostatic sinus; ureteritis; and septic pyelo-nephritis.

15. The chief symptoms of vesical stone are: sudden interruption of the urinary stream due to the rolling of

the calculus against the vesico-urethral orifice when the patient attempts to urinate while in the upright position; pain extending to the extremity of the urethra and glans penis, intensified in walking, or jolting in a carriage; greatly increased frequency of urination, attended with sharp pricking, scalding pains all along the urethral canal, especially during the emission of the last drops of the often bloody urine; almost intolerable pruritus of the foreskin which lengthens and thickens owing to constant pulling and scratching to relieve the itchy sensation; frequent painful priapism; purulent bloody, often alkaline, irritating urine; and sundry annoying nervous reflexes.

16. The diagnosis of vesical stone may be based on the right interpretation of the history and symptoms of the case, but the crucial test is to touch the stone and this can properly be done mediately only with a metallic explorer, before the use of which, however, the urethral canal is examined with soft, flexible, acorn-tipped web-bougies with a view of ascertaining its capacity and also the degree of sensitiveness of its mucous membrane and of that of the bladder.

17. In case of inordinate sensitiveness of the urethra or great irritability of the bladder it is not wise to begin the search for stone with a metallic instrument, but to prepare the patient by first putting him to bed and prescribing quinine, diluent drinks, and hyoscyamin in doses of one milligram thrice each day, and by using daily vesical irrigations, the soft catheter employed for this purpose serving to blunt the urethral sensitiveness, so that in the course of six or eight days the sufferer is likely to be in condition to withstand the exploration

with a rigid metallic searcher. These precautions are of importance insomuch as the precipitate use of metallic exploring instruments is often serious in its effects, and it is always safest to follow all the injunctions stated in the preparation for the final exploration in all cases as well as in preparation for the indicated operation.

18. In sounding for stone no use is any longer made of those metallic sounds of ordinary curve and length such as are employed for dilatation of the strictured urethra, because they cannot be moved in the vesical cavity with the degree of freedom needed in the search, and because of defects which are too evident to require particularising. One of the best of exploring instruments is Langlebert's lithophone which is a short-beaked, probe-pointed rectangular metallic catheter thirty-five centimeters long inclusive of its stopcock and cylindric handle. The diameter of its probe-point is five and a half millimeters, and that of the shaft four and a half millimeters; the eye of the catheter looking upward to avoid the verumontanum during introduction and withdrawal. The instrument is provided with a small detachable drum to be used at the end of the handle when resonance is desired in the class room. One of the advantages of this sort of exploring catheter over the solid searcher is that the liquid contents of the bladder can be decreased or increased without withdrawing the instrument. But as a general rule this is not necessary, since one hundred grammes of liquid in a calculous bladder suffice for its thorough exploration.

19. The final exploration is conducted as follows: The surgeon, standing on the right side of the recumbent patient, whose hips are raised upon a hair pillow,

takes the stone-searcher in his right hand, seizes the glans with the left thumb and index finger, retracts the prepuce which is held back between the middle and the annular finger palm up, drops the point of the instrument into the urinary meatus, slips it slowly down the urethral canal until it reaches the bulbo-membranous junction, coaxes it past that point, depresses the handle between the thighs with gentle onward propulsion, when the beak soon enters the bladder, to be moved to and fro, then rotated to the right and to the left, or reversed in search of any calculus that may lie behind an enlarged "third lobe" of the prostate. The moment the beak of the searcher comes in contact with a stone, slight friction by the to and fro movement makes it known whether the surface of the calculus is smooth or rough, and helps to estimate its size which is afterward determined with precision by the use of a lithometer or of a light lithotrite or of the cystoscope, with which, of course, rugosity is discerned. Some idea may be formed of the degree of hardness of a stone by striking it with the beak of the searcher to which a quick movement of semi-rotation is given; a sharp high-pitched ring being then very clearly audible when the little drum of the lithophone is in position, and suggesting a compact hard stone, whilst a dull, flat thud indicates the presence of a soft, phosphatic mass. In the case of multiple calculi, scores, or even many hundreds, having sometimes been found in the human bladder, their number beyond three or four cannot be determined with exactness, and not over eight or ten are discernible through the cystoscope. The detection of encysted and chatoned calculi or of those existing in cases of prostatic

enlargement, is attended with no little difficulty, and demands a patient and prolonged search for any chatoned concrection and for the orifice of a cyst enclosing one or two stones, as well as the reversal of the searcher's beak in the endeavor to find a small concretion hidden behind an enlarged prostatic "third lobe." It is particularly in these circumstances that the cystoscope and a skiagraph show their great value in the completion of the examination.

20. The value of skiagraphy in the diagnosis of vesical as well as of renal calculi has been so thoroughly tested that it can no longer be contested even by those who have so obstinately opposed its use, for by the skilful employment of this process, not only is the presence of a vesical or renal stone demonstrable, but its size, form, and general characters are determinable. Dr. Beck in his excellent article on the subject, published in December, 1905, said: "The chemical composition of the calculi of the urinary tract determines the greater or lesser depth of their shadows. The greater their atomic weight, the greater their density, and consequently the more distinct the shadow. Thus, calculi composed of oxalate of lime show the most distinct shadows. Their shadows are even deeper than those of bone-tissue. Next to them we find those consisting of phosphate of lime, while the uric acid calculi give the faintest shadows." Amongst the divers methods of precision employed in the diagnosis of certain diseases of the urinary organs, none has accomplished greater marvels in ascertaining the nature of local affections and in establishing indications of treatment than the endoscopic and skiagraphic processes.

21. The diagnosis once completed, a chemical and microscopic inspection of the urine is carefully effected in order that the surgeon may be assured of the absence of any serious implication of the kidneys such as would be certain to contra-indicate a cutting or crushing operation; then choice is made of the operative method that may seem the most likely to give safe and speedy relief to the patient.

22. The cure of sufferers from stone in the bladder is accomplished through the aid of the surgeon's knife or the lithotrite. The cutting operation is designed to reach the bladder for extraction of the stone either below or above the pubes. Of the infra-pubic operation there have been at least fourteen methods and nearly as many varieties of these methods, but few of which have survived. Of the supra-pubic operation there have been no less than six methods and varieties, the simplest of which only is now in use. The crushing operation, styled lithotrity, designed to reach the bladder through the urethra without the aid of the knife, was originally undertaken with a greatly complicated mechanism and unwieldy apparatus that, after trial, were gradually replaced by a simple mechanism, handier apparatus, and lighter instruments, all of which facilitated the operative process and rendered it of more certain, rapid, and safe execution.

23. The infra-pubic incisive methods of operating now employed are: the lateral; the bi-lateral; the medio-lateral; the medio-bilateral, and the median of Allarton. Since beginners may sometimes be perplexed in making choice amongst these methods, the merits of each of which have been so lauded by its advocates,

an endeavor will be made, in the following notes, to set forth such advantages as each may possess in special circumstances, and so perhaps establish its particular indication.

24. Of the lateral perineal method of operation the desirable features are: it affords an ample outlet for stones of medium size; it effects complete drainage of an inflamed bladder, and therefore is especially suitable in cases of obstinate cystitis consequent upon the long presence of calcium oxalate or of very rugous uric acid stones, or of phosphatic gravel.

25. The lateral method is clearly indicated: in young children, to whom, however, any of the perineal methods may be applied with better results than to adults; in adolescents, whose bladders happen to be inordinately irritable; and in the case of adults who are tormented by such persistent cystitis that temporary drainage of the bladder is as essential to a cure as is the removal of the stone. When, in such a case, the calculus exceeds three centimeters in size, it is broken up, the fragments extracted, and the fine detritus washed away.

26. The lateral perineal method of operating is contra-indicated in patients affected with calculi of small size that can be destroyed at one or two lithotriptic sittings, and in cases of friable stones of three centimeters in mean diameter, provided the bladder be in such favorable condition as to tolerate two or three lithotriptic sittings with immediate aspiration of the fragments. It is also contra-indicated in cases of elderly men suffering from urethro-vesical obstruction. In such cases, trachelo-cystectasy with median incision or excision of the bar or immediate enucleation of any existing tumor or

enlarged lobes, fulfils the two indications of relieving the obstruction to urination and of freeing the bladder from calculous material.

27. The bilateral method has for its main features the external crescentic and the double prostato-vesical incisions permitting the extraction of a larger stone than can be removed from the tract of the unilateral cut without laceration of the parts. But since lithoclasty following the unilateral method has been found so safe and efficient, the advantage claimed for the double cut does not seem to hold good. Nélaton's prerectal lithotomy is one of the varieties of the bilateral method. The chief advantage claimed for this prerectal variety is avoidance of the urethral bulb. The bugbear of excessive hæmorrhage from division of the bulb has led to many unnecessary and sometimes hurtful devices for avoiding this much dreaded bulb, which in point of fact, is very often cut during lithotomy and seldom bleeds excessively when freely divided, as in external perineal urethrotomy; a slight wound being much more likely to bleed profusely because undiscovered at first. To Mr. Skey, lithotomists are indebted for the exposure of this fallacy.

28. The medio-lateral is but a variety of the lateral method; the external incision only being median, and, as already stated, the main advantages claimed for this variety being that it is simpler, more easily and quickly performed than the lateral method, less liable to be followed by hæmorrhage, and less dangerous because of the restricted limits of the incisions.

29. The medio-bilateral variety of the bilateral method is still employed by some surgeons who urge the claim

for this variety that it is of easier and safer performance than the bilateral method. Briggs, of Nashville, was the chief exponent, among Americans, of this mode of treatment of the calculus.

30. The median method of Allarton, which in reality is a trachœlo-cystectasy, opens a route to the bladder permitting the safe extraction of small and medium-sized calculi. Larger stones, such as measure three or even five centimeters in mean diameter, have occasionally been extracted during this procedure upon adults, and proportionately large calculi in adolescents and children, but only in cases of very soft and extraordinarily extensible prostates. Under ordinary circumstances, forcible extraction of large stones is as hurtful in the median as it is in any other infra-pubic method. On this account even Allarton advised that large calculous masses be broken and extracted piecemeal.

31. The desirable features of the Allartonian method are said to be: the median external incision, by which excessive hæmorrhage is avoided; dilatation instead of incision of the prostate and vesical neck; and little, if any, liability to infiltration of urine. One very objectionable feature of the operation, as ordinarily performed, is the digital dilatation of the prostato-vesical tract especially in young children whose urethræ have been torn across and even severed from the prostate in the attempt to dilate the parts with the finger thrust onward with no little violence. It is therefore wise to substitute for the finger any instrument, with expansible blades, suitable to effect the desired dilatation.

32. This median method is indicated in children, in adolescents, and in those adults whose bladders do not

require drainage. It is indicated also in the case of elderly calculous men suffering from prostatic obstruction due to urethro-vesical bars or to enlargement of the lobes, needing incision or excision in the first, and enucleation in the second case when the combined operations of lithotomy and prostatotomy or prostatectomy or enucleation may be advantageously performed. Median lithotomy is contra-indicated when the bladder requires temporary drainage on account of obstinate cystitis, or when the indication for lithotrity is plain.

33. Lithoclastic trachœlo-cystectasy, otherwise known as perineal lithotrity, when stripped of the details prescribed by Dolbeau for its performance, bears some resemblance to Allarton's method except in the accomplishment of the dilatation of the prostato-vesical tract exactly to the extent of two centimeters, made with a specially constructed dilator much safer in its application than the antero-posterior digital dilatation of Allarton. Between these two methods, there is another difference which is that the Allarton operation was originally designed for the removal of small and medium-sized stones, the fragmentation of large stones being merely incidental, whilst the Dolbeau method was intended primarily for the fragmentation of large stones and the immediate removal of the detritus. Like Allarton's method, this operation is contra-indicated when the bladder requires drainage as effected by incision of the prostato-vesical tract.

34. Supra-pubic cystotomy now performed with very much greater frequency than it ever was resorted to even in the time of Souberbielle, its great exponent in France, and too often employed in the case of those small calculi

that ordinarily yield to a single lithotriptic sitting, is really indicated only in cases of large compact stones too hard to be broken up in perineal cystotomy or in trachœlo-cystectasy; in cases of stones complicated with tumors of the bladder; and in cases of foreign bodies which cannot be extracted by the urethral route. In general the supra-pubic method requires an ample bladder, but the operation has been successfully accomplished when the vesical capacity has been markedly decreased. The first recorded high operation for the removal of a large stone was done upon the empty bladder of a young child and was successful (Franco).

35. Cysto-lithotrity, the crushing of stone in the bladder with an instrument introduced by way of the urethra, is adapted to adults, though it is often employed in adolescents, but is not a desirable or safe procedure in children, especially those under ten years of age.

36. This operation is indicated in cases of free, friable, small, or medium-sized stones. Under favorable circumstances stones of larger size are successfully crushed, and within certain limitations plurality of stones do not contra-indicate the operation. The chief requirements of lithotrity are: that the patient shall be in a fair physical state; that the urethra shall be ample or susceptible of soon being rendered so; and that the bladder shall be in such condition as to tolerate the use of the necessary instruments.

37. The existence of a urethral stricture is not a contra-indication of lithotrity provided the canal can be freely dilated or even enlarged by internal urethrotomy, but a very narrow, resilient stricture in the perineal

region, especially if it be of traumatic origin, contra-indicates lithotrity and demands external division followed by trachœlo-cystectasy or cystotomy.

38. Urethro-vesical obstruction, unless very extensive, does not contra-indicate lithotrity. Contracture of the vesical neck often ceases soon after expulsion or extraction of the detritus. But in cases of thick bars at the neck of the bladder and enlargement of the prostatic lobes, lithotrity should not be thought of as the sole expedient, since the only hope of effecting a radical cure is in the use of a cutting operation for the relief of the bladder from the stone and from the prostatic obstruction to urination.

39. When the bladder containing a stone is permanently contractured, when its walls are much thickened, when its capacity is extremely diminished, or when it is inordinately and uncontrollably irritable, lithotrity is contra-indicated and cystotomy imperative provided the kidneys be not hopelessly involved, for advanced disease of the bladder ureters and kidneys contra-indicates both lithotrity and lithotomy.

40. Before particularising the divers modes of operating for vesical stones, it may be worth while to cast a glance at the evolution of these operations; beginning with a sketch of the history of lithotomy in the next chapter.

XXVI

LITHOTOMY: ITS EARLY HISTORY AND MODERN ADAPTATIONS

1. The earlier epoch in the history of lithotomy is enveloped in such impenetrable darkness that even the erudite Deschamps * could not ascertain the precise time when the bladder was first cut for the extraction of a stone. His exhaustive account of this operation to the end of the eighteenth century not being very accessible, the writer ventures to give, in concise abstract, the early history of lithotomy and its modern adaptations, for the benefit of beginners, in the hope of inducing them to institute further inquiries into this subject so important in its theoretical and practical aspects as well as in its copious literature contributed by many thousand writers.

2. In prehistoric times, when men were afflicted with vesical calculi, it is likely that their pangs continued unrelieved until death ended all physical misery. It is likely, too, that many sufferers were so fortunate as to discharge the stone when but a wee bit of gravel. The observation of such cases doubtless led some bold, enterprising medicine man to attempt the removal of the offender, which, when of diminutive size, he succeeded

* *Traité Historique et Dogmatique de l'Opération de la Taille*, Paris, 1796–97. 4 vol. in 8vo. A new edition prepared by Bégin was published in 1826.

in causing to be expelled from the bladder by more or less violent means. In all probability he had often witnessed the spontaneous expulsion of gravelly masses during urination, and finally determined to try what is now called artificial lithecboly, of which a heroic process was described by Prosper Alpino (1591) in his work on the medicine of the Egyptians, and which consisted in inflating the bladder and making pressure thereon and thus forcing out the stone or extracting it by buccal aspiration. From Alpino's account it seems likely that inflating the urethra and bladder to effect dislodgement of a small stone had a very remote origin. *Lithecboly*, so often incomplete, the stone being jammed in the anterior part of the urethra, must have suggested *lith-exæresy*, its extraction—perhaps with some crude instrument. It is scarcely necessary to say that no sensible modern surgeon would resort to inflation of the urethra and bladder to effect artificial lithecboly, since he can do so by dilating the urethra and contractured vesical neck with bougies or sounds. These modes of ridding the bladder of calculous concretions were the early precursors of lithotomy, which, intended to signify the cutting of the kidney, ureter, urethra, or bladder for the removal of a stone, is of such ancient date that no writer has ventured to say exactly when it was first performed. That cysto-lithotomy was commonly done in the time of Hippocrates is attested by his having required his disciples to take oath never to undertake it, but leave its performance in the hands of experts. Dujardin, in his history of surgery, said that it may be reasonably inferred that the Hippocratic prohibition was owing to the fact that some family was then in

exclusive possession of a secret way of performing this operation.

3. The word lithotomy, according to Celsus, was coined from *lithotomos*, which was the nickname of Ammonius of Alexandria, who lived in 276 B. C., and who was surnamed *lithotomos*, stone cutter, because, with a sculptor's chisel and mallet, he was wont to reduce the size of stones that were too large to be extracted through the vesical cut. Daniel Le Clerc (1729), in his history of medicine, said substantially that "for the improper word lithotomy, should be substituted cystotomy, which would be more exact since it is now the bladder and not the stone that is cut." Nevertheless, the wrong designation of this operative process is likely to continue in use for a long time to come.

4. *Nephro-lithotomy*, the cutting for stone in the substance of the kidney, has been employed frequently during the second half of the nineteenth century and is no longer regarded with the awe which it formerly inspired. The organ is generally reached by incision in the lumbar region. In the majority of cases the stone is lodged in the pelvis of the kidney. Even in those cases it is safe to reach the pelvis by splitting the kidney longitudinally along its free border, for such a cut is not attended with much hæmorrhage since there are no large vessels in that line of incision, as demonstrated by the writer in 1889, from the corroded preparation of several kidneys whose arteries had been injected with celoidin.

When not too long delayed, nephro-lithotomy has given the most satisfactory results; the percentage of mortality being very small. Exploratory operations on

the kidney have not proved dangerous though many have been done and no stone found.

5. In the lumbar operation the renal pelvis is sometimes directly opened without interference with the substance of the kidney. In that case the operation is strictly a pyelo-lithotomy, and is liable to be followed by a lumbar urinary fistula.

6. *Uretero-lithotomy*, which is a modern operation, has been performed in three situations. First, by a preliminary trachœlo-cystotomy, when the calculus is lodged near the vesical extremity of the ureter; second, in the lumbar region, the calculus being extracted through a longitudinal incision of the ureter which is then carefully stitched; and third, near the sacro-iliac sychondrosis through an incision such as is made for ligature of the primitive iliac artery. The results of these operations have been very gratifying.

7. *Urethro-lithotomy* in the phallic region was first described by Celsus. That method of removing urethral calculi continued to be employed until the advent of lithotripsy, since which time the cutting operation has been abandoned, except in cases of very large stones. Urethro-lithotomy is now generally performed in the scrotal, perineal, membranous, and prostatic regions. It is adapted to cases of urethral calculi complicated with narrow, undilatable strictures, and to cases of large stones lodged in any of these several regions of the urethra when urethro-lithotripsy is not practicable.

8. *Cysto-lithotomy* or litho-cystotomy, by any method soever, has always been regarded as very difficult and attended with risks to be kept constantly in view by the operator. No beginner should undertake its perform-

ance until he has acquired a thorough knowledge of the anatomy of the parts and has repeatedly practised the operation on the cadaver. The Celsian account of the manner of proceeding was so graphic that his description and mode of operating were adopted to the letter, and it was not until the sixteenth century that a modification was recorded to have been made of that method under the designation of *apparatus major;* eighteen hundred years having expired, from the time of Ammonius to Roman John, without any progress in the mode of performing lithotomy.

Further modifications occurred from the seventeenth to the nineteenth century, and the following named methods were devised: the lateral, lateralised, bilateral, quadrilateral, median, medio-lateral, medio-bilateral, pre-rectal, recto-vesical, lithoclastic-cystotomy, and lithoclastic-trachœlo-cystectasy. The Franconian epi-cystotomy, condemned by its author, had a short revival in the seventeenth, a second in the eighteenth, a third in the beginning of the nineteenth, and a fourth revival, likely to be lasting, toward the close of the nineteenth century. Of the fourteen methods named above, nine belong to the nineteenth century.

9. *The Celsian method,* whose use did not cease even long after the introduction of its first modification, was styled lithotomy by the lesser apparatus to distinguish it from the lithotomy by the greater apparatus, because of the few instruments employed in its performance, to wit: fingers, a knife, and a blunt hook. To accomplish the operation, the stone was forced toward the vesical neck by pressure in the hypogastric region with the right hand, while with two fingers of the left passed into

the rectum the stone was brought forward and gripped in that position. A crescentic incision, across the perinæum, with the horns looking toward the ischia, was made close to the anal margin, the "neck of the bladder" cut transversely, and with the blunt hook, the stone was extracted. From this description, it may be justly inferred that the Celsian was, in reality, a bilateral operation. It was used chiefly in children up to the age of fourteen. Adults fared so badly under the process that they were seldom cut.

10. *The Marian method*, by the so-called *apparatus major*, owing to the many instruments required in the performance of the operation, was invented during the year 1525 by John of the Romans in his old age, and described by his friend and disciple Mariano Santo, of Barletta, whose name it bears and whose work "*Libellus Aureus de Lapide Vesicæ per Incisionem Extrahendo*," was published in 1543. Mariano then instructed Octavian de Ville, of Rome, in that art of lithotomy, and Octavian, during a visit in France, imparted it to Laurent Colot, and returned to Rome where he soon died. So that, in 1556, Laurent remained the sole possessor, in France, of the method of lithotomy by the greater apparatus, and the secret was kept in the Colot family for about one hundred and fifty years. The manner of performing the operation was finally made public by François Colot, the last of the name in medical biographies. The essential steps in that operation were: to make a straight cut on the left side near and parallel to the median perineal raphé, to lay open the bulbous urethra, and from that point, to stretch or perhaps tear the parts to the vesico-urethral orifice by the successive

introduction of blunt instruments of increasing size until the passage was sufficiently ample for the easy extraction of the stone which was to be broken, with rather clumsy lithoclastic forceps, in case of inordinate dimension. The Colots attained great skill and success in the practice of the operation, and the last of them gave his experiences honestly, candidly, and intelligently. His posthumous work is well worthy of careful perusal. François Tolet, a contemporary of Colot, also wrote a book on lithotomy which well merits study.

11. *The lateral method* came into use during the seventeenth century when there still existed, in Italy and France, some itinerant lithotomists; among them one Pauloni, who was wandering through the southerly provinces and with whom Jacques Baulieu, born in 1651, known afterward as Frère Jacques, became acquainted and learned the Marian and Celsian methods when only twenty-one years of age and with no education beyond reading and writing. Nevertheless, he strove to improve upon these modes of operating, using at first, as a conductor, a sound without groove and making a transverse unilateral section through the prostate and vesical neck. It is said, however, that this lateral cut was not original with Baulieu but had been invented long before by the accomplished anatomist and skilful surgeon Foubert, who performed the operation without conducting sound; plunging the knife through the perinæum and cutting the parts laterally. His success was prodigious but his boldness found no imitators.

12. Baulieu, after travelling through southern France and performing successfully many lithotomies, went, in 1697, to Paris, where at the Hôtel-Dieu, he operated with

success, by his "new method," on a man aged forty. The manner of the operation not satisfying those who witnessed it, the operator was asked to repeat its steps on the cadaver. Méry was charged with the dissection and examination of the parts involved in the operative procedure in order to ascertain what advantages the method might offer. Without waiting for the report, which was delayed, Baulieu went to Fontainebleau with letters to Fagon, the physician, and Félix, the surgeon of Louis XIV. Through their good-will he was permitted to lithotomise several patients who all recovered. Returning to Paris in the spring of 1698, he operated upon sixty patients, of whom, according to Méry, twenty-five died. The surgeons present at these operations declared that Baulieu, in his speech and acts, gave no evidence of possessing the least knowledge of anatomy, and they were convinced that he was guided only by a blind routine. . . .

13. Jacques then resumed his peregrinations; visiting different towns in France and Germany, where he is said to have effected many cures. Fagon, who was suffering from the stone, induced him to go to Versailles, where he was required to make, under the eye of Duverney, further cadaveric experiments which resulted in a marked improvement—to be stated later. He then operated on the living in thirty-eight cases, all of which happily recovered. Notwithstanding these favorable results, Fagon, on whom he had expected to operate, was prevailed upon to give the preference to Maréchal, the eminent surgeon. Chagrined by this disappointment, he left Versailles in 1702, but toward the end of that year was summoned by the Maréchal de Lorges, who needed

his services. The maréchal, before submitting himself to the operation and wishing it first to be tried on others under his auspices, made provision for the housing of twenty-two calculous patients, who were cut by Baulieu with complete success during the spring of 1703. But when it came to his turn, the maréchal succumbed a few days after the operation, owing to advanced disease of the upper urinary organs. He had waited until the operation was contra-indicated! Disheartened by this sad failure, Baulieu left France to travel in Italy, Germany, Belgium, and Holland. He returned to France in 1716, and in a few years died.

14. *The lateralised method*, styled in England the *lateral*, though, in part, suggested in the writings of Paul of Ægina and of other ancients who recommended that the incision of the teguments be made obliquely to the left of the median perineal line, was not known to Baulieu, its real inventor, who first put the complete method into practice after having profited by the anatomical instructions received from Méry and Duverney. He began the perineal cut where ended the incision for the Marian operation; substituting, at the suggestion of Méry, a grooved staff for his original conductor and thus made an important improvement on his first method. This was before he had visited Holland and had been so cruelly misrepresented by Rau, of Amsterdam, who, though employing with success Baulieu's later method, insisted that, by his alleged own way of operating, the body and not the neck of the bladder was cut. Those who followed to the letter Rau's pretended method met with the very worst results, such as infiltration of urine in the pelvis, besides other sad accidents.

This wicked deception was an almost fatal blow to Baulieu's lateralised method, which, however, was reinstated after the discovery and exposure of Rau's bad faith, and some further modifications were made later, chiefly in the necessary instruments. But brother Jacques did not live long enough to enjoy his triumph, for he had passed away in 1720 at the age of sixty-nine.

15. The first operator to revive the lateralised method, under the title of the "*lateral way*," was the eminent London anatomist and surgeon William Cheselden, who had had such ill success with Rau's supposed method that he concluded to conduct his operations on the lines of Baulieu's lateralised method, but added, to the necessary instruments, a blunt gorget which he passed into the bladder along the groove of the staff; this gorget serving as a conductor for the forceps designed to grasp and extract the stone. In the year 1730 he published his "*Short Historical Account of Cutting for the Stone.*"

16. Almost simultaneously with Cheselden, Percher and Garengeot had revived the nearly forgotten lateralised method of Baulieu. And Morand, Pouteau, and Ledran in France, Sharpe in England, and Heister in Germany, did each his share toward improving the lateralised method.

17. Lecat, of Rouen, is said to have invented the first cutting gorget to be used instead of the knife for the prostato-vesical incision, but the instrument proved to be worthless. The next instrumental invention was by Jean Baseilhac, better known as Frère Côme, who devised his *lithotome caché;* taking the cue from the *bistouri caché* of Bienaise. The first operation with the

lithotome caché was performed, at the request of Baseilhac, in 1748, by his friend de la Roche, and was entirely successful. The main advantages claimed for this lithotome being the certainty and precision of the vesico-prostatic cut. This excellent instrument, variously modified, is used to this day by many surgeons.

18. The great success attained by Baseilhac and other operators who employed this lithotome roused the envy of Lecat, who decried it, and vaunted the qualities of his own instrument, but to no purpose. This again raised the question of cutting gorgets, and Sir Cæsar Hawkins' gorget, designed to incise the prostate and vesical neck, found advocates in Louis and Desault, of Paris, and Physic, of Philadelphia, each of whom made thereof such modification as suited his fancy. These gorgets were intended to cut from before backward, and this was the main objection to them, although Dudley, of Kentucky, and other American surgeons employed them with great success. The judgment and skill of the operators rather than the characters of instruments were evidently the main factors in the success attained in lateral lithotomy by Dudley and his contemporaries.

19. For the vesico-prostatic cut, Sir William Blizard preferred the beaked straight bistoury which bears his name, whilst other lithotomists have completed the cutting part of the operation with the same scalpel that had served for the external incision; the essential step observed in modern lateral lithotomy being to give the external and also the deep incision the oblique course between the urethra and left ischium, long since directed by good operators, so as to avoid injury to the rectum or to any vessel likely to bleed inordinately.

20. *The bilateral method* was proposed by Ledran in 1756, afterward by Chaussier, then by Béclard in 1813, and by Turck, of Strasbourg, in 1818. It was finally adopted, in 1824, by Dupuytren, who used the Celsian external incision but gave great precision to the deep cut with a double lithotome constructed on the principle of Frère Côme's *lithotome caché*, and slightly curved flatwise. Among the Americans who have resorted to Dupuytren's mode of performing this operation was Paul F. Eve, of Tennessee, whose results were so gratifying that he was no advocate of the bisectors then in use, one of the earliest of which being Alexander H. Stevens' prostatic bisector described as resembling a large olive with a beak at its extremity, cutting edges at the sides parallel to its long axis, and a straight handle. The main object in using this instrument was avoidance of rectal wound. James R. Wood's bisector was constructed with the same object and on the same principle as Stevens' but resembled a half olive cut lengthwise, with the blades along the edges of the flat part of the half olive. Post's bisector differed from these in its not being olivary. The crescentic external incision being used in all these bilateral operations.

21. *The quadrilateral method* was proposed by Vidal and published in his thesis for the doctorate in the year 1828. The object of the quadruple division was to facilitate the extraction of large calculi. His proposition was not to make all the four cuts at once, but after a bilateral section, to try extraction, which failing, to make a third incision upward and outward involving only the vesical neck and prostatic base; the fourth cut to be made only if the first three should prove insuffi-

cient. He had not then performed the operation on the living, but it was employed with success by Velpeau, Guersant, jr., Goyrand of Aix, Rolland of Toulouse, and Roux Martin of the Navy. Rolland's patient was sixty-nine years of age; the stone weighed four ounces and five drachms, and was five inches and a half in circumference. Roux Martin's patient was eighty-four years of age; the ovoid stone weighed six ounces, and was five inches and two-thirds in its smallest diameter. Both patients recovered, and both surgeons had resorted to the multiple sections of the base of the prostate only when they found it impossible to extract the stone.*

22. *The median method*, suggested by the Marianian, was proposed, in 1825, by the Pisan surgeon Vacca Berlinghieri as a substitute for the urethro-recto-vesical operation of Sanson, and consisted in making an incision in the middle line of the perinæum, in opening the urethra at its bulbo-membranous junction and, with a beaked bistoury, cutting the vesical neck and prostate very close to the median line, taking care to avoid injuring the ejaculatory ducts. This trachœlo-cystotomy is the only operation worthy of the name median; the "median lithotomy" of George Allarton, of South Molton, England, being in reality a trachœlo-cystectasy, and safer than the Berlinghierian method. Mr. Allarton first published a description of his method in 1854 under the title of "Lithotomy Simplified," and his "Treatise on Median Lithotomy" appeared in 1863. This Allartonian operation is so well known and so often performed

* *Vidal (de Cassis). Traité de Pathologie Externe et de Médecine Operatoire*, Paris, 1841, pp. 503–504.

in America that for the present no further remarks are needed concerning its merits.

23. *The medio-lateral method*, the cutting being guided by a nearly rectangular grooved staff, was employed by Sir James Earle in 1812, by Nathan R. Smith, of Maryland, and by Auguste Mercier, of Paris, and was adopted and modified, in 1846, by Buchanan, of Glasgow, who used an absolutely rectangular staff deeply grooved laterally from the angle to within a short distance of the beak. In these several modes of operating the external incision is short and the deep cut is horizontal. The chief advantages claimed for these operations being that they are more easily and quickly done than the lateral, and less dangerous because of the restricted limits of the incisions. Henry Lee performed the medio-lateral operation guided by a centrally grooved curved staff, and regarded it as simpler and quite as safe as the method by the rectangular staff.

24. *The medio-bilateral method*, devised by Civiale in 1829, consists in opening the perineal urethra centrally and making the deep cut with a straight, double-bladed lithotome. The advantages claimed for this method are that the operation is easier performed than the bilateral and that it causes less bleeding. Among its American advocates were Hutchison, of New York, and Briggs, of Tennessee. The American lithotome being slightly curved flatwise, and similar to Amussat's.

25. *The pre-rectal method*, which is but a slight modification of the bilateral operation of Dupuytren, was proposed by Nélaton, and consists in carrying the dissection backward until the prostate is reached and opened at its apex for the insertion of the double litho-

tome with which the deep cut is made; the main object being to avoid the urethral bulb. But, as already said, this bugbear of profuse bleeding from a wound of the bulb has led to many unnecessary, tedious, and sometimes hurtful devices for avoiding the bulb, which is almost always cut in perineal lithotomy, and seldom bleeds alarmingly when it is freely divided; a slight wound being more likely to bleed excessively.

26. *The recto-vesical method* was performed by Sanson in 1816, by Sleigh, and by Maisonneuve. The first method of Sanson was an external urethro-recto-vesical process, for at one longitudinal cut he laid open the urethra, the prostate, the base of the bladder, the anal sphincter, and the lower end of the rectum. The second Sansonian method was an external recto-vesical operation wherein the anal sphincter was cut but the perineal urethra untouched. Maisonneuve spared both the perineal urethra and sphincter, and Sleigh did likewise leave intact the perinæum; reaching and opening longitudinally the base of the bladder through the rectum, after stretching the sphincter. The alleged advantages of Sleigh's operation were avoidance of hæmorrhage and the facility with which a large stone was removed. Sleigh's operation has been performed a few times in this country, and in one case the vesico-rectal wound was successfully closed with wire sutures.

27. *Lithoclastic cystotomy*, though performed more than two centuries before the Christian era by Ammonius, surnamed *lithotomos*, and resorted to by other early lithotomists, such as Franco, Paré, the Colots, Covillard, Lecat, Heister, and Baseilhac, and in modern times by Civiale and others, was proposed, in 1830, as a regu-

larly systematised operation, by Malgaigne in his *Thèse de Concours*, wherein he described it as "*taille lithotriptique*," a combination of lithotomy and lithotrity, applicable to cases of calculi too large to be extracted in their entirety.

28. *Lithoclastic trachælo-cystectasy* was styled perineal lithotrity by Dolbeau in his treatise on stone in the bladder published in 1864. The word cystectasy was used, in 1842, by Willis to designate artificial expansion of the vesical neck, but since it really means expansion of the bladder, the affixion of a qualifying word is demanded for exactness, hence *trachælo*-cystectasy. The Willis operation was an external urethrotomy in the membranous region, and expansion of the vesical neck, with Arnott's dilator, sufficient to permit the extraction of a moderate-sized stone. He advised fragmentation of large calculi; so his operation bears some resemblance to that of Dolbeau. He quoted John Douglas as proposing, in 1727, gradual dilatation of perineal fistulæ with sponge or gentian tents until the tract was ample enough to admit forceps with which to extract a small stone. Dolbeau's perineal lithotrity differs from Willis' operation in the mode of expansion of the vesical neck which is effected by a six-bladed metallic dilator to the diameter of two centimeters, in the means of fragmentation attained by the use of a slender but strong lithoclast, in the employment of the scoop or of small forceps for extraction of the fragments, and in free irrigations for the expulsion of the finer detritus.

29. *The supra-pubic method* is credited to Germain Colot by several authors, but careful examination of the question of priority fails to show that this operation

of epicystotomy was ever performed by Germain Colot. That medical myth seems to have arisen from a very imperfect laic account contained in old chronicles wherein is given the date, January, 1474, when a criminal condemned to be hanged was, by permission of Louis XI, subjected to a surgical operation on condition that should he survive he would be pardoned. He was cut open, his bowels examined and replaced, and the body sewed up. He recovered, but the exact nature of the operation is not stated, nor is the name of the operator given. The real inventor of the supra-pubic method was the eminent French surgeon Pierre Franco, who, at Lausanne, Switzerland, in the year 1560, performed the operation on a boy two years of age, after failing to extract the calculus through a perineal cut, when he at once opened the bladder above the pubes and removed a stone of the size of a hen's egg. Although the child made a good recovery, Franco condemned the operation in his work published in 1561. This condemnation was approved by surgeons of the time and the operation found no advocate until 1581, when Rousset, in his work on the Cæsarian section, strongly recommended the high operation of Franco, after a careful study of the anatomy of the bladder in both sexes, but never performed it on the living. Guy Patin, in a letter dated June 18, 1649, spoke of having taken part in the defense of a thesis by Nicolas Piètre on the Franconian operation which had been performed successfully in Paris on men and women. This revival was very short. John Douglas strove to improve and popularise the high operation, and in 1719 published his "*Lithotomia Douglassiana.*" Cheselden, after many trials, expressed his disappointment in the

operation and took up the "lateral way," although, in 1723, he had published a "Treatise on the High Operation of the Stone." Heister wrote on the supra-pubic method in 1728 and was followed by Morand, whose treatise thereon appeared in the same year. Later the operation, as modified by Baseilhac, was performed by several French and English surgeons. The results not being satisfactory, the operation was again given up. Then, early in the nineteenth century, Souberbielle, Carpue, the English surgeon, then Damourette, Drivon, Belmas, Amussat, and others, endeavored to reinstate it, but the mortality was such as to discourage its further trial. The final revival was begun in the last quarter of the nineteenth century. Asepticism and the simplified modern mode of performance have given such good results that the operation is now regarded as a much safer and easier procedure than it was even in the hands of the greatest surgeons of the past.

30. The chief cutting operations for stone in the bladder now performed in this country are the lateral, the median of Allarton, and the supra-pubic. However, some surgeons still give preference to the bilateral, medio-lateral, or medio-bilateral; but, for good reasons, all reject the quadrilateral, pre-rectal, and recto-vesical operations.

31. *The lateral operation* is adapted to the young child, and to the infant—whose bladder, be it remembered, is almost an abdominal organ rising high in the shallow pelvis—to the adolescent whose bladder is inordinately irritable, and to those adults whose contractured bladders need temporary drainage owing to obstinate cystitis. It is contra-indicated in cases of small calculi

triturable at a single lithotriptic sitting, and in cases of large friable stones when the bladder is likely to be tolerant of one prolonged sitting of litholapaxy, provided the general condition of the patient warrants such a procedure.

32. *The median Allartonian operation* is not adapted to infants and very young children when the finger is used for dilatation of the parts as recommended by Allarton; the danger of this process being the severance of the urethra from the prostate—an accident by no means rare. Dolbeau's or any suitably constructed instrumental dilator will effect with safety the desired expansion of the vesical neck; this and some of the other good features of perineal lithotrity may well be taken advantage of in the performance of the Allartonian operation, which, so modified, is rendered safer in children and is best adapted to adolescents and to adults whose bladders do not require drainage. This method is also adapted to cases of small stones in patients affected with permanent urethro-vesical contracture or bars requiring incision; the operation being thus converted into a true median trachœlo-cystotomy. In cases of large frangible stones, the modes of fragmentation, extraction of fragments, and riddance of the bladder from the finer detritus, prescribed by Dolbeau, are surely worth adapting in the performance of the Allartonian operation.

33. *The supra-pubic operation* is adapted to cases of infrangible stones too large to be extracted by way of the perinæum. It is also adapted to the removal of foreign bodies that cannot be extracted by the urethra or through a perineal opening. The ample bladder is a

favorable condition to the high operation, but its permanent contracture with diminished capacity is not a contra-indication. Even some of the old lithotomists did not regard artificial distension of the bladder as absolutely necessary, for they often performed the Franconian operation upon empty bladders for the removal of stones or foreign bodies. In these modern times the bladder is too frequently opened above the pubes for the extraction of small stones removable through any of the safer perineal operations, or even triturable at one lithotriptic sitting. There is now no excuse for adherence to a single method of removing stones from the bladder, in view of the many modes of proceeding from which to make choice. The wise surgeon selects that mode of operating, which in his judgment is best adapted to the peculiarities of the case and to the physical condition of the patient.

34. *The accidents of infra- and supra- pubic* lithotomy need only a few words. The principal untoward happenings common to the several modes of operating by way of the perinæum, are: failure to reach the groove of the staff with the cutting instrument and consequent injury to adjacent parts; wound of the rectum; wound of the body of the bladder; wound of anomalous vessels followed by excessive hæmorrhage; and laceration of the vesical neck and prostate in forcible extraction of a large stone.

35. The main accidents of the recto-vesical operations are: wounds of the ejaculatory ducts, spermatic canals, seminal vesicles, and of the peritonæum; and laceration of the parts during extraction of the stone, favoring urinary infiltration.

36. Of the supra-pubic operation, the chief accidents are: wound of the peritonæum and of the small intestine with consequent septic peritonitis; and laceration of the parts during extraction of a large stone, with consequent infiltration of urine.

37. *Of the results of lithotomy*, correct information is not attainable by the exclusive examination of mortality bills of particular operations, but some approach to the truth may be made by adding all the figures of the recorded recoveries and deaths and striking an average, although even then the attainment of exactness will still be impossible owing to the fact that the results of very many operations are never published, and that almost as many are not accessible. William Coulson has endeavored to strike that average from a large collection of cases, embracing the results of operations performed in Great Britain and Ireland, France, Germany, Austria, Italy, Russia, Denmark, Sweden, and America, consisting of six thousand five hundred and five cases of all lithotomy operations, at all ages, both in males and females, exhibiting a mortality of one in six and fifty-six one-hundredths.

38. It is well known that large proportions of fatalities are attributable to advanced disease of the upper urinary organs, or to intercurrent affections of other organs, and that in such cases the operation only hastens death which, even without help from the surgeon's knife, would soon occur. If the conditions contra-indicating surgical intervention could always be ascertained, the mortality from any of the modes of lithotomy would be comparatively small. The beginner should, however, remember that more wisdom is needed to determine if an operation

is indicated than skill for its performance, and that this skill must be great.

39. More favorable results have been attained in private than in public practice, partly by reason of early application of the wealthy for relief, partly owing to the hygienic surroundings. But now that sufferers among the poor are earlier warned, hospitals better equipped, and asepticism rigorously observed, the results of public operations are already far better than ever before. Coulson collected five hundred and forty-seven cases operated upon in private practice. Of these only twenty-five died, or one in twenty-one and eighty-eight one-hundredths.

40. The results of the different methods of operating may be worth contrasting. Of the Celsian method, the results are so little known, that they will not be comprised in this brief examination. Of the Marian operation, Coulson asserts that the mortality was one in four and eighty-nine one-hundredths. Of the mortality of Baulieu's lateral operation, the figures were so contradictory that it was not possible to form a just estimate thereof. On the one hand he was reputed to be almost uniformly successful, and on the other he was said to fail; witness Méry's report of the sixty operations with twenty-five deaths. The lateralised method yielded better results. The mortality from Cheselden's "lateral way" was one in seven and thirty-eight one-hundredths.

41. Of the lateral operation as it is now understood, Gross of Philadelphia made a collection of 1929 cases with 187 deaths, or one in ten and thirty-one one-hundredths. The number of his own operations was 115 with ten deaths, or one in eleven and five-tenths. Sir

Henry Thompson tabulated 1827 cases of lateral lithotomy, performed in England, with a mortality of one in about eight. Of 426 cases of lateral lithotomy, performed with the gorget, in private practice, by American surgeons, the mortality, according to Gross, was one in twenty-three and seven-nineteenths. Dudley, who used the gorget and whose cases were mostly in private practice, performed the operation two hundred and seven times, and lost only six cases, or one in thirty-four and five-tenths. Valentine Mott lost but one case in his first fifty lithotomies, but afterward the fatalities were more frequent in his practice.

42. Of the median Allartonian operation, the results up to the year 1870 were very gratifying. In England and America 364 operations were performed on patients whose ages ranged from one and a half to seventy-seven years; 332 recovered and 32 died, or one in eleven and thirty-seven one-hundredths. Of these 364 operations 139 were performed in America with the occurrence of only five deaths, or one in twenty-seven and eight-tenths.

43. The results of perineal lithotrity in the practice of Dolbeau were fair, in consideration of the facts that in all the cases the stones were large or multiple, and the ages of half of the patients ranged from fifty to seventy-two years. Of his thirty cases, five proved fatal, or one in six.

44. Of the supra-pubic operation, the mortality, according to Coulson, was one in three and eight one-hundredths. Since the last revival of the method, the results of this operation have compared favorably with those of the lateral and Allartonian methods.

45. The mortality from the bilateral operation in the time of Dupuytren was one in four. The record of Eve, of Tennessee, is very much better. Of eighty-seven patients subjected by him to bilateral lithotomy, only eight died, or one in ten and seven-eighths.

46. From the medio-lateral operation, performed upon his rectangular staff, Dr. Buchanan claimed the mortality to be only one in ten and four-tenths.

47. In the medio-bilateral, Briggs had a phenomenal success. Of his hundred and thirty-six operations only three proved fatal, or one in forty-five and a fraction.

48. Of Sleigh's recto-vesical operation, the mortality was about nineteen per cent.

49. It is a noteworthy fact that the achievement of some surgical processes often conduces to the discovery or to the just appreciation of things not well known in anatomy or in the practice of surgery. Thus lithotomy and its accidents have prompted the closer study of the parts concerned in the operation whether it be on the kidney, ureter, bladder, or urethra. So, in these modern times nephro-lithotomy is not regarded as such a formidable operation as in early days, and the same may be said of uretero-lithotomy. The difficulties often arising during the attempted introduction of an explorer or of a lithotomy staff through the urethra doubtless contributed to the discovery of the obstructions which became known as strictures, and also to the discovery of the prostate about the middle of the sixteenth century.

50. Lithotomists of the sixteenth and seventeenth centuries sometimes removed accidentally portions of the enlarged prostate in the grasp of the forceps during the extraction of a stone without untoward effects. The

knowledge of this fact emboldened later operators to wrench or to enucleate such prostatic growths during lateral lithotomy; prominent among those was Sir William Fergusson. The pre-rectal lithotomy of Nélaton suggested the right way to reach the enlarged prostate for its enucleation.

51. The accidents of recto-vesical operations impelled the great anatomist Charles Edward Issacs to make an exhaustive study of the base of the bladder and of the affixed genital organs, and also of the pelvic peritonæum, which revealed the fact that this serous membrane very often overlaps the base of the normal prostate, and that therefore the great frequency of this anomaly is a sufficient reason why these recto-vesical operations should be abandoned.

52. Supra-pubic lithotomy has brought to view intra-vesical protrusions of the prostate and led to their avulsion or to their excision immediately after extraction of the stone. Amussat is recorded as having accomplished that incidental operation early in the nineteenth century. This probably induced Dittel in 1885 and Belfield in 1886 to employ epicystotomy not solely for the purpose of extracting calculi but for excising intra-vesical prostatic growths. Since the last revival of supra-pubic lithotomy, the uncertain method of avulsion of villous tumors of the bladder through a perineal cystotomy has been discarded, and these tumors are now brought into view and removed with precision and safety through a supra-pubic cystotomy.

53. Such are some of the discoveries to which lithotomy has led and for which modern surgeons are greatly indebted to the labors of the true pioneers in the

wilderness of the surgery of the urinary organs; notably Ammonius, John of the Romans, Franco, Baulieu, and Cheselden.

54. In the foregoing very brief sketch, it was sought to point out only the main features in the early history and present adaptations of some of the methods of lithotomy.

XXVII

MODERN LITHOTOMY

1. The foregoing notes on the main features of the early history, modern adaptations, accidents, and results of litho-cystotomy seeming insufficient for the purposes of beginners, it was thought that a few additional annotations of a more practical character might be of service. Hence the following attempt to set forth the present modus operandi in different methods of proceeding.

2. The operations of litho-cystotomy at present as generally performed, comprise the perineal and supra-pubic. The perineal include the lateral, bilateral, medio-lateral, medio-bilateral, and median methods. Of the supra-pubic operation the several early methods have been discontinued, leaving but one simple mode in which the operation is accomplished.

3. For the lateral perineal operation, the requisite instruments are: a grooved metallic staff; a scalpel; a probe-pointed scalpel; thumb forceps; artery clamps; a beaked bistoury; a cystotome; several pairs of lithotomy forceps; a strong lithoclastic forceps; a scoop; and an irrigation apparatus.

4. The staff is twenty-six centimeters in total length. From its beak to the distance of ten centimeters the shaft is deeply grooved and of sufficient diameter to moderately distend the urethra; the rest being of a

lesser diameter. This grooved part of the shaft, a mere shell of metal which ends at the base of the beak, approaches the rectangular form; its nearly horizontal portion being somewhat longer than that of the ordinary sound used for urethral dilatation. The smooth handle, five centimeters long and two centimeters and a half at its broadest part, is smooth and slightly concave on both surfaces. Several sized staffs are provided for adults as well as for adolescents and children.

5. The scalpel is fifteen centimeters in total length; its cutting edge being five centimeters long. A beaked scalpel of the same dimensions is added to the list in case it is judged best to use such an implement for the deep cut instead of the sharp-pointed scalpel, the beaked bistoury or the cystotome.

6. The beaked bistoury, such as that devised by Sir William Blizard, has a straight blade whose cutting edge is six centimeters in length, its handle is smooth, long and firm.

7. The cystotome may be of any of the several modifications of Frère Côme's *lithotome caché*. The simpler in construction the better and the easier cleansed and kept in good order.

8. The steel forceps, for extraction of the stone, are the straight plain-bladed, the slightly curved, and the nearly rectangular. The shafts are crossed and so disposed that when the instrument is opened for seizure of the stone the handles will not be so far apart as to impede the action of the instrument. The extremity of each handle is in the form of a ring similar to the rings of scissors. Forceps with fenestrated blades are now very seldom used.

9. The lithoclastic forceps comes into use when the stone is too large to be safely extracted in its entirety. One of the best of these was devised by Dolbeau. This very strong, well-tempered steel lithoclast is thirty-eight centimeters long. The shafts are crossed as in the case of lithotomy forceps. The straight jaws are such that when closed they can be easily passed through an opening of two centimeters in diameter. These jaws which are seven centimeters long, are sufficiently thick and powerful to bear all the pressure needed to crunch a very hard stone. The extremity of each jaw is provided with two strong, tooth-like projections that serve to gnaw the stone from the circumference toward the center and so reduce its bulk that it may be readily seized and broken up. The male jaw has a prominent longitudinal serrated central crest, and the female jaw is slightly concave with short peripheral serrations designed to prevent the stone from slipping out of the lithoclast's grasp.

10. The steel scoop, about sixteen centimeters long and olive-pointed at the distal end, is primarily designed to remove small calculi or detritus, but its shaft being provided with a longitudinal flange serves also as conductor to the forceps in case of great depth of the perinæum, or of prostatic enlargement. In such cases the blunt gorget was formerly employed as conductor to the forceps, and is still sometimes so used.

11. The nature and uses of the other instruments named need no special description. All instruments are placed within easy reach of the operator who has assured himself of their condition and of their aseptic state.

12. The immediate preparation of the patient for the operation consists in the administration of a copious enema a few hours before, in the thorough shaving and cleansing of the perinæum, in drawing off all the urine if it be foul and irrigating and disinfecting the bladder; leaving in not less than one hundred and twenty grammes of the fluid.

13. Of the assistants, one administers the anæsthetic agent; one, on the left side, holds the staff and supports the scrotum; and one, on the right side, mops the wound and staunches hæmorrhage.

14. The position of the patient, after complete anæsthesia, is dorsal with the thighs flexed upon the pelvis, the legs under the thighs, and the feet suitably secured to strong vertical steel rods fastened to the corners of the operating table; the hips being drawn to the edge of the table so that the perinæum is brought close to the operator seated on a low stool.

15. The first step of the operation is the introduction, by the operator, of the staff which, after its contact with the stone, is confided to the care of the chief assistant who with the right hand, holds this staff so as to render its groove accessible. This post of honor is assigned to one already skilled in surgery.

16. The second step is to make through the thickness of the perineal tissues, an oblique incision beginning about one millimeter to the left of the median raphé at a point three centimeters anterior to the anal margin and ending near the ischial tuberosity. The nail of the left index finger then seeks the groove of the staff and guides the point of the knife which, entering this groove, is pushed onward to incise obliquely the membranous

urethra, and, without withdrawing the instrument, lateralised division of the prostate and vesical neck may be made, or a probe-pointed scalpel may be substituted, or this deep cut may be effected with Blizard's beaked bistoury or with a sheathed lithotome. The operator then passes his left forefinger into the bladder in order to ascertain the extent of the prostato-vesical cut.

17. The third step is extraction of the stone. The staff having been removed, the forceps, guided by the left index finger or by the longitudinally crested straight part of the scoop, is slowly and gently introduced; the blades grasping the crest of the scoop. As soon as the bladder is reached, the conducting scoop is withdrawn and the spoon-like blades of the forceps are turned flatwise and opened widely so that one of them depresses the lower vesical fundus, allowing the stone to roll therein and be seized. Then, if the instrument, with the stone between its blades, can be freely moved to and fro and rotated, it is certain that no part of the mucous membrane is caught; otherwise, it is disengaged by slightly relaxing the hold upon the calculus. After taking these precautions, moderate traction is made in the direction of the long axis of the superior pelvic straight, and the stone cautiously extracted and handed to the chief assistant who washes it to look for those smooth facets which generally indicate the presence of multiple calculi. But even should no facets be discovered, the operator reintroduces the forceps in search of other concretions. The process of extraction is often very difficult or impracticable when the stone exceeds four centimeters in its smallest diameter, and even has to be discontinued to give place to lithoclasty as the

safest mode of ridding the bladder of such a large calculous mass the forcible extraction of which would surely cause serious laceration of the parts.

18. Seizure of the stone is very difficult if it happens to be lodged behind the pubic symphysis and is there firmly held by an inordinately irritable bladder. In such a case, the forceps is withdrawn, and the finger introduced to disengage the stone from its awkward situation. This process often has to be supplemented by external manipulation over the hypogastric region. Even then, the angular forceps is needed to effect the seizure and extraction of the offender. Much delay in the operation is also caused in the case of chatoned or of encysted stones which cannot be grasped by the forceps until freed by tearing, with the finger nail or any other proper means, the edge of the chatone or the wall of the cyst.

19. The bilateral method, as advocated by Dupuytren and his followers, consists in making across the perinæum, close to the anal margin, a crescentic incision with the horns pointing toward the ischial tuberosities; in opening the membranous urethra longitudinally near its prostatic junction; and in incising the prostate and vesical neck with a double lithotome. The rest of the procedure does not differ materially from that of the lateral operation.

20. Of the medio-lateral and medio-bilateral methods, enough has already been said in notes 23 and 24 of the preceding annotations.

21. For the median operation of Allarton, the requisite instruments are: a broadly grooved beaked staff; a straight, sharp-pointed bistoury; a broadly grooved

long director; a dilator for the prostato-vesical tract; lithotomy forceps; a lithoclast; a scoop; and the minor instruments already named.

22. The following is a description of the procedure in Allarton's own words: "I introduce a grooved staff in the usual manner, and of the usual size, and confide it to an assistant, with directions to keep it perpendicular and hooked up against the pubes; I then introduce the index finger of my left hand into the rectum, placing its extremity in contact with the staff, as it occupies the prostate, and press it firmly against the staff, so as to steady it; then, with a sharp-pointed straight knife, with a tolerably long and rough handle, I pierce the perinæum in the middle line, about half an inch above the anus, or at such distance as may appear necessary to avoid dividing the fibers of the external sphincter. I carry the knife steadily and firmly on till it strikes the groove of the staff, the deep sphincter lying between the knife and the directing finger, which enables me to judge of the distance as the knife passes along. If the incision be not made exactly in the median line, the contracting fibers of the injured muscles draw the point of the knife from its direct line and interfere with the accuracy of striking the staff, hence the advantage of the rough-handled knife which affords a firmer hold and better purchase. Having struck the groove of the staff, I move the point of the knife along the groove towards the bladder a few lines, and then withdraw it, cutting upwards, so as to leave an external incision of from three-quarters of an inch to one inch and a half, according to the presumed size of the stone; the escape of urine indicates the entrance to the urethra. I then

introduce a long, ball-pointed probe or wire through the external opening into the groove of the staff and slide it into the bladder to sufficient depth to insure its safe lodgment in that viscus, and withdraw the staff. I then well grease the index finger of the left hand and pass it along the probe, with a semi-rotary motion, through the prostate into the bladder; which procedure is achieved without difficulty, and when the stone is free it comes at once in contact with the finger, and, if of moderate size, passes at once into the wound on withdrawing the finger, the patient having power to strain upon and thereby facilitate the extraction of the stone; this last mentioned power being one of the great advantages of the operation. The incision being made strictly in the median line, no muscles are divided, and the integrity of the bladder being preserved it is under the control of the patient who exerts, at the wish of the surgeon, a powerful propulsive effort which keeps the stone in or in contact with the internal extremity of the wound, where it is easily seized by the forceps and extracted by mild persevering traction. Now, as the aperture is necessarily the size of the finger which produces it, if the stone be large, some other dilating power must be employed in addition to the dilating effect of the forceps and stone combined; for this purpose, Weiss' three-bladed female dilator, Arnott's hydraulic dilator, or what is at once ready and effective, the addition of the vulcanised India-rubber finger-stalls one over another, until the finger is sufficiently enlarged for the purpose, the outer covering being well lubricated with lard before being introduced. But Arnott's dilator, where it can be procured, is by far the most efficacious,

though not the most expeditious means. Should the stone be of unusual size, it may readily be broken by a short, strong and straight lithotrite, or by a strong and suitable pair of forceps closed by a screw. . . . Should the stone resist the efforts to crush or extract it, the wound can readily be enlarged upwards or downwards, by dividing the deep fascia, or even be converted into a bilateral aperture sufficient to extract any average sized stone."

23. The advantages claimed by Allarton for his operation are: "The impossibility of missing the bladder; the smaller amount of cutting than in the lateral operation, the neck of the bladder being uninjured; the smaller amount of blood lost, the prostate being merely dilated, not incised; the urine being at once passed by the urethra as well as by the wound, unless union by the first intention be effected; the facility with which the stone is reached, the patient being able to propel it toward the wound; the very short distance between the external opening and the interior of the bladder; the capability of breaking or crushing the stone, and washing out the bladder, and freeing it from any minute particles; the small amount of pain; the absence of danger from urinary infiltration; no muscle or vessel of any consequence being divided, no subsequent imperfection can arise; no danger of wounding the rectum; the rapid recovery, the patient being able to go about the next day; and the great facility with which the operation can be done. . . ."

24. The instrumental part of the Allartonian operation has been modified by several American surgeons, amongst whom were Little and Markoe, who devised

special staffs and directors and who advocated digital dilatation of the prostato-vesical tract. But this mode of dilatation was not regarded as safe by other surgeons after witnessing its evils, particularly in the case of very young calculous children, and who therefore chose to effect dilatation by means of Dolbeau's or of other dilators.

25. The after-treatment in these divers perineal operations is practically the same. Before the patient is put back to bed, the mattress is covered with India-rubber cloth over which is placed the so-called draw-sheet, suitably folded under the buttocks, besides the ordinary sheet. Against the wound and between the upper parts of the thighs, is tucked an abundance of antiseptic gauze to absorb the urine as fast as it flows, and to be renewed as often as saturated; the draw-sheet itself to be changed twice daily. When the immediate effects of the anæsthetic agent have passed away, a free dose of quinine is given, and a broth or a cup of milk may be taken. During the first twenty-four hours, the decubitus should be dorsal; afterward, the patient may change his position from side to side at will. It happens sometimes, in the lateral and other perineal operations, that, from tumefaction of the parts, urine escapes by the natural route up to the end of the second day, but as the swelling ceases the flow is again from the wound. After the median operation, the bladder very soon regains its retentive power, and in children all of the urine from first to last is passed normally through the urethra. The wounds heal in from two to six weeks after the cutting operations, and, as a general rule, in from ten to fifteen days after the Allarton or the Dolbeau method.

In convalescence, and for two or three weeks thereafter, frequent hip baths are taken and the bladder daily irrigated. This second precaution is too often neglected. The subsequent treatment is conducted in accordance with the general and special principles of hygiene and rational medicine.

26. Supra-pubic cystotomy, as now done for the extraction of a stone or of a foreign body, requires but little distension of the bladder and none of the rectum. Petersen's colpeurynter, so much used during many years for the purpose of pushing up the bladder, is no longer regarded as essential to the easy performance of the operation of epicystotomy in cases of stones or of foreign bodies.

27. The surgical armament needful in this operation consists of a soft India-rubber catheter, a scalpel, thumb forceps, a grooved director, artery clamps, retractors, a sharp-pointed curved bistoury, a blunt-pointed curved bistoury, lithotomy forceps, curved needles, and an irrigation apparatus.

28. The operation is conducted as follows: After due preparation, such as the cleansing of the intestines, the shaving of the hypogastrium and pudendum, and the disinfection of the bladder, all effected on the previous day, the patient is placed upon a firm, narrow table and rendered insensible to pain. The pelvis is slightly raised; the hypogastrium and pudendum again cleansed; the bladder irrigated two or three times in quick succession with a warm antiseptic solution about one hundred and fifty grammes of which only need be retained therein; the catheter is then clamped or plugged and a bit of rubber tape is wound around the penis and held

fast by an artery clamp to prevent the escape of fluid by the side of the catheter. A median longitudinal incision with the scalpel is made through the skin and underlying tissues down to the linea alba about eight centimeters in length ending a little below the summit of the pubic symphysis. The pyramidal muscles are pressed aside, and the aponeuroses forming the linea alba brought into view to be incised lengthwise in the middle line, and the edges held apart by retractors to expose the prævesical connective tissue. Free irrigation of the wound is then followed by upward retraction of the prævesical layer with the left index finger's point with which the peritoneal fold is held out of harm's way while the sharp-pointed bistoury is plunged into the vesical cavity at one centimeter below the end of the finger; making a median longitudinal downward cut sufficient to admit the same finger for estimating the size of the stone—if it have not been already determined by skiagraphy—and ascertaining the degree to which the vesical wound needs extension for the slow cautious extraction of the stone seized in its smallest diameter with suitable forceps. So soon as the finger is passed into the bladder the rubber tape is unwound from the penis, the catheter released from its clamp or plug and the fluid allowed to escape from the bladder. It is then that the incision is enlarged in downward direction by the blunt pointed bistoury guided by the finger still in the bladder for conducting the forceps which is to seize and extract the stone. After this a final exploration is made with the forceps in search of any small calculi that may have been concealed by the larger stone. The next step is to close completely the vesical wound by stitches of

catgut or of silk, and to similarly close the external wound. In applying the bladder sutures care is taken to avoid inclusion of the mucous membrane. The external stitches embrace the cutaneous muscular and aponeurotic layers. A long, rubber catheter, passed by the urethra into the bladder, is left in position for syphoning the urine during the first twenty-four hours and daily replaced by a fresh catheter for the five or six subsequent days when it is finally left out and six or eight daily evacuating catheterisms employed until it is judged that the internal wound is sufficiently consolidated to bear the strain of ordinary distension by the urine. Under favorable circumstances, the closed vesical wound heals primarily. Otherwise, the external wound is reopened and filled with gauze to absorb leaking urine, and regular catheterism practised until complete cicatrisation. But the idea of leaving a catheter in position for supra-pubic drainage of the bladder is now scarcely ever entertained.

29. Complete closure of the bladder wound and external incision immediately after supra-pubic lithotomy was done in 1859 by Henry S. Hewit, of New York, who used silken threads for the purpose. The following is abstracted from his report of the case. "The incision in the bladder was immediately closed by four points of interrupted silk suture inserted with the aid of a sharp artery needle. . . . The sutures used in closing the external wound were . . . carried deeply through the substance of the recti muscles . . . on bringing the edges of the incision together the long ends of the cystic sutures were brought out of the lower end of the opening. Lastly, a gum . . . catheter was passed

and secured . . . and perfect drainage was in this manner maintained, and infiltration absolutely prevented. . . . On the fifth day, the bladder gave evidence of integrity, by expelling its contents independently, and the catheter was removed. . . . After passing water once or twice, the patient became nervous and refused to repeat the effort, concealed his condition until the accumulated fluid ruptured the new adhesions, and the urine flowed through the track of the sutures. . . . Infiltration could not take place under these circumstances, and the accident was of no moment. . . . The fistula was not interfered with and closed on the twenty-fourth day from the operation and the nineteenth from its occurrence. On the tenth day the sutures of the bladder had come away."* Twenty-five years afterward the writer, who was present at the operation, saw the patient then in excellent health.

30. Lithoclasty, as applied to the reduction of calculi that are too large for safe extraction in any of the perineal methods, needs some special annotations. It seems strange that the chief object of this excellent process of the Alexandrian lithotomist whose nickname was given to the operation of cutting for the stone, should have been ignored for so many centuries, although attempts were made for its rehabilitation by Franco, Paré, the Colots, Tolet, Covillard, Heister, Baseilhac, Lecat and others from the sixteenth to the eighteenth century; but it was condemned, by the majority of surgeons, discarded, and soon almost frogotten. The credit of its

* New York Journal of Medicine, Third Series, 1859. Vol. vi, pp. 217–219.

reintroduction, in 1830, is due to Malgaigne, who showed its real value and named it lithotriptic lithotomy. Nevertheless its progress was very slow until Dolbeau formulated the operation, which he styled perineal lithotrity, to be employed solely for breaking up large stones. The lithoclasty, according to this method, should follow and not precede the trachœlo-cystectasy, but some surgeons have begun the operation by breaking the stone with a strong lithotrite introduced by the urethra, and then made an external urethrotomy in the membranous region and dilatation of the prostato-vesical tract through which they extracted the fragments. This procedure is not as safe and easy as lithoclasty through the perineal wound.

31. Ever since the labors of Dolbeau became known in America, lithoclasty has been often employed in cystotomy and in trachœlo-cystectasy for cases where the stone was of a size that forbade its safe extraction; forcible extraction being regarded as a barbarity of the distant past which no prudent operator of the present is likely to undertake, knowing the ill effects of extensive laceration of the prostato-vesical tract; of urethro-recto-vesical fistulæ, and of other sad consequences of the old habit of extracting large bladder stones.

32. The results of the lithotomy formerly so often performed in cases of large stones were extremely unfavorable, as told by the historians of the operation who showed forcible extraction to be the indirect and frequently the direct cause of death in the majority of instances. These writers, long since, called attention to the sad results of the harsh procedure without, however,

suggesting a remedy. The death of one patient in three subjected to the operation for extraction of large vesical stones, was not thought to be an excessive fatality until lithoclasty had reduced it to one in six. Such, at least, was Dolbeau's experience, for, from 1863 to 1872, he had performed thirty perineal lithotrities for large stones and lost but five cases. The ages of his patients ranged from 3 to 72 years, and fifteen of them were over fifty years old. The writer's experience in lithoclastic cystotomy and trachœlo-cystectasy is limited to ten cases. The ages of the patients ranged from 4½ to 74 years; only one child and one adolescent; four of the others being over fifty years old. In one case the stone was reached through the lateral and in another through the bilateral operation. In this second case large multiple stones, one of which was chatoned, were rapidly broken up; the detritus weighing 292 grammes. The patient 69 years old, made a good recovery. In one case the lithoclasty was effected through Allarton's median operation, and in the remaining seven Dolbeau's method was used. The weight of the detritus extracted in eight cases ranged from 14 to 80 grammes. Nine of the patients were cured, and one, æt. 74, died of sapræmia on the seventh day. In this case the detritus weighed 64 grammes.

33. From the time that Dolbeau acted upon Malgaigne's suggestion of fragmentation—and even before, for Allarton had already acknowledged the value of the reduction of large stones before their extraction—lithoclasty became the common process as against the rude forcible extraction of entire stones of inordinate magnitude. The outcome of this happy change in practice

has been a marked decrease in the mortality bills of the divers methods of perineal lithotomy.

34. The following suggestions on the required attributes of the surgeon, on what is conceived to be his proper conduct, and on some of the difficulties which, in the performance of lithotomy, he may occasionally have to surmount, together with other hints and bits of information, may be perhaps of practical use to novices. The reminders relating to the conduct of the operation are intended to include its main steps, namely: the introduction of the staff; the external incision; the internal incision; the introduction of the forceps; the seizure of the stone; and the extraction of the stone.

35. Lateral perineal lithotomy, one of the most brilliant and also one of the most difficult of surgical achievements, requires for its proper conduct that the surgeon shall be well acquainted with the anatomy of the parts, that he shall be endowed with sound judgment, prompt decision, a cool, clear head, and a steady hand, and that he shall have acquired special skill by practice on the cadaver, and so be equal to any emergency. These qualities are of course as necessary in the case of all other methods of lithotomy and enable him to perform his duties without haste or excitement. Prior to the discovery of anæsthesia by inhalation, great rapidity in the performance of lithotomy was believed to be essential, but at present slower and more deliberate action is observed by the operator, who, however wastes no time in the accomplishment of his task. His thorough knowledge of the special regional topography, qualifies him to make with precision the cuts absolutely

necessary and sufficient to reach the bladder and permit the easy extraction of the stone.

36. The introduction of the staff is not to be undertaken until there is every assurance of the amplitude of the urethral canal and, even then, caution is to be observed in avoiding the vulnerable points, namely: its peno-scrotal and bulbo-membranous junctions. The early lithotomists, who lay much stress on the observance of this precaution, practiced for the purpose what they styled the *tour du maître*, which consisted in directing the point of the staff downward toward the perinæum until it passed the peno-scrotal junction, then, while making with the handle a semi-circular sweep from the central line to the patient's left, brought the point of the instrument again to the center as it reached the perinæum, lifted it to the upper urethral wall and finally carried it through the membranous region and so into the bladder. The whole process was accomplished in a small fraction of a minute while the master was seated or standing between the thighs of the patient who was already in the lithotomy position. It is essential, even in our days, that the surgeon feel the stone with the staff before proceeding to the operation, though its presence may have been ascertained by radiographic or cystoscopic exploration. The chief assistant to whom is confided the care of the staff as soon as introduced, should devote his whole attention to this until the cutting part of the operation is finished, otherwise he hampers and annoys the operator whose knife may miss the staff's groove and wander away at the risk of entering the rectum or doing other serious mischief.

37. The external incision, rightly and boldly made,

is a fair indication of the surgeon's ability to carry the operation to a successful completion. This lateral incision, extending from the perineal center obliquely downward and outward midway between the ischial tuberosity and the anus, involves not only the skin but the subjacent tissues that lie close to the urethra which can be felt with the finger whose nail is pressed against it to detect the groove of the staff preparatory to plunge in the point of the knife with which the canal is laid open to the prostatic apex. Instead of the lateral, some surgeons make a transverse cut in the perineal center to reach the urethra, whilst others employ the Celsian incision for this purpose. The bleeding which follows the external incision is ordinarily slight and needs no special attention other than the twisting of one or two superficial vessels, and so leave the wound clean. But in nearing the urethra it sometimes happens that an anomalous artery is divided which requires immediate ligature.

38. The internal or prostato-vesical incision which may be made, as did Cheselden, with the scalpel used for the external incision, or with Blizard's beaked bistoury, needs a depth only sufficient to admit into the bladder an object of about four centimeters in circumference, for the reason that the parts will yield to enough dilatation for the extraction of a calculus of six centimeters in circumference. There has been, at different times, much discussion concerning the depth that should be given to this incision; some surgeons advocating the minimum, or mere nick in the tissues, and others have argued for the maximum, involving the whole thickness of the prostato-vesical tract—a rash, danger-

ous cut often attended with profuse hæmorrhage. The outcome of these discussions, which occurred during the first half of the nineteenth century, was that conservative lithotomists took the middle course and were content with a prostato-vesical cut which did not exceed five millimeters in depth and which, aided by the dilatability of this region, answered ordinary purposes. Such an incision was shown to be practicable with absolute precision by means of the modified *lithotome caché* of Frère Côme. The same instrument with two cutting blades is now used in the bilateral and medio-lateral methods. As a general rule, severe hæmorrhage need not be expected if the deep incision be moderate in depth.

39. The dextrous introduction of the forceps, and the proper seizure and safe extraction of the stone demand long practice on the cadaver, for, on the living, each of these processes is often attended with no little difficulty. A very deep perinæum or an enlarged prostate offers, to the passage of the forceps, an impediment to be overcome only by the use of a small blunt gorget or of the straight part of the scoop slid along the groove of the staff to serve as conductor for the forceps which is slowly and gently coaxed into the bladder. Otherwise it will not reach its destination but tear its way into the tissues lying between the prostate and rectum. Under ordinary circumstances, immediately after completion of the prostato-vesical cut, the left index finger, guided by the staff still in position, is passed into the bladder for exploration. The staff is then removed and the forceps introduced without hinderance if it follow the axis of the superior pelvic straight.

40. Seizure of the stone is easily effected when the jaws of the forceps are widely opened flatwise and depression of the lower vesical fundus made with one of them so as to allow the stone to fall within their grasp. Neglect to practice this simple manœuvre has caused much unnecessary delay in the operation, for when the jaws of the forceps are insufficiently opened they fail to embrace and hold, but, as it were, only pinch or rasp the side of the stone which constantly slips away from them, much to the bewilderment of the operator who finally declared his inability to catch the stone and hands the instrument to a bystanding colleague, who seizes it with the greatest ease because he knows exactly how to do the trick.

41. Extraction of even a small stone perplexes the operator who forgets that the forceps, armed with the stone, cannot safely be pulled out of the bladder except it follow the axis of the superior pelvic straight. In his plight he pulls with undue force in the direction of the pubic arch, to the serious damage of the soft parts, or makes equally violent traction in the opposite direction to the extent of endangering the rectum. Then, too, in endeavoring to extract a larger rough stone, seized in the wrong direction, he incurs the risk of lacerating the prostato-vesical tract or even the rectum. A surgeon may perform all parts of lithotomy with great skill and brilliancy until he comes to extraction of the stone and fails because of his neglect to observe the simple rules prescribed for the successful execution of this last act of the operation.

42. Lithotomy in children is deserving of greater consideration than the same operation in adults, and often

presents greater and more serious difficulties. Perhaps, as suggested by Sir William Fergusson, the reason why it was long regarded as an easy operation was from the results rather than from the manner of proceeding, for the mortality was so markedly less than it was during manhood; the average number of deaths, according to Sir William, being about one in thirty children cut for the stone; whilst some statisticians give the number of deaths after lithotomy in adults as one in eight. Sir Henry Thompson prepared a table of 473 lithotomies performed upon children of from one to five years of age. Of these 473 cases, thirty-three died, or one in fourteen and one-third. In this table are also recorded 377 operations upon children of from six to eleven years old. Of these 377 cases, sixteen died, or one in twenty-three and a half cases. This, of course, shows decidedly a lesser death rate than in adults; children bearing such operations the better owing chiefly to greater average soundness of their upper urinary organs.

43. In performing lithotomy upon very young children, operators of little experience too often fail to realise that the infantile pelvis is extremely shallow and that consequently, the bladder is almost an abdominal organ more difficult to reach from the perinæum than is the adult organ. To this peculiarity, when it is not recognised or heeded, may be ascribed failure to enter the viscus with the knife or forceps, and the occasional difficulty in the extraction of the stone when the passage of the forceps has been fortuitously effected. The accident of severing the urethra from the prostate when digital dilatation is attempted during the median lithotomy of Allarton, is owing chiefly to the peculiar relations of

the pelvic organs. It is clear then that the divers methods of lithotomy by the perineal route require very much more caution and gentleness in infants than in adults, and that they are not by any means as easily performed as it may seem at first sight. But the difficulties lessen with the growth of the child, so does the mortality as shown in the second part of Thompson's table.

XXVIII

LITHOTRITY; ITS DEVELOPMENT AND PRESENT STATUS

1. The following notes are intended to exhibit a concise tracery of the development of lithotrity from its germinal to its present state, and to set forth the general characters of the necessary instruments first invented and of the improvements made thereon to render the operation precise, safe, and effective.

2. These notes are preceded by a brief statement of some of the methods of treatment of vesical stones precursory to the operation of lithotrity.

3. *Internal medication*, with pretense of gravel and stone dissolution, has long been and is still largely exploited by unscrupulous persons. That sort of treatment was hailed as a blessing by the unwary, particularly during the seventeenth and eighteenth centuries. The people's dread of lithotomy, on account of the loss of blood, and the large mortality consequent, as they ignorantly believed, upon the operation, offered a golden opportunity to deceivers who made the rashest promises to cure calculous patients without the use of the knife: and for a long time empirics of all kinds throve from the sale of nostrums vaunted as infallible remedies for the radical cure of the gravel and stone. The most notorious of those impostors was one Joanna Stevens, or Stephens, who sold, in 1739, for five thousand pounds sterling, the secret of her worse than useless alleged remedial agents

to the British Parliament, notwithstanding the protestations of respectable physicians. This blind credulity in the efficacy of internal medication was not confined to the laity, for both in England and France, even medical men of high repute were deluded, for a time, with the idea of destroying vesical stones by means of medicines administered through the mouth. Among the French believers was Pierre Desault, of Bordeaux, who, in 1736, published a dissertation on stone in the kidney and bladder, "with a simple method for its dissolution without injury to the urinary organs." The supposed inoffensive method consisted in free imbibition of the alkaline waters of Barèges. This "simple treatment" not only failed, but rather served to aggravate the existing cystitis due to the presence of the stone, as did the Stevens preparations whose base was alkaline. The charlatans afterward engaged in the exploitation of the alkaline treatment increased steadily in numbers to meet the demands of innocent believers in all countries; and "lithontriptic" medicine men are still in requirement! One of the most commonly used of the "lithontriptics" is a tamarack-resin soap swallowed by confiding victims in the form of the bolus. All of these "lithontriptic" medicines are as ineffective for good as they are powerful for evil. The deceived seldom discover the wiles of the deceivers who are so well aware that ignorance is the parent of credulity as to take every advantage of that knowledge.

4. *Direct medication* of the stone by divers means was the next process. The iatrochemists of the early part of the nineteenth century gave earnest consideration to the question of dissolution of bladder stones. Fourcroy

found that uric acid calculi were soluble in a strong lye of carbonate of potash; that those of calcium oxalate yielded to dilute nitric acid; and that the phosphatic were destructible by dilute hydrochloric acid. But these interesting laboratory experiments were scarcely applicable to the intolerant human bladder. The physicists, too, tried their hands at the disintegration of stones before and even after the introduction of lithotrity; proposing something like electrolysis, and this also was doomed to failure. The injection of normal children's urine was suggested and used as a solvent of vesical stones in adults, but with negative results. Pure water, also lime water, was likewise thrown into the bladder, with intent to dissolve calculi. Stephen Hales, the English naturalist of the eighteenth century, who contributed so much valuable information on air and water, is said to have experimented on a calculous female dog; using a double-current catheter through which he sent a large quantity of warm lime water, expecting to dissolve the stone, but in vain. Without knowledge of Hales' experiment, Jules Cloquet, in 1820, invented a double-current catheter for irrigation of the human bladder with pure water as a solvent of stone and reported one cure. Other physicians long before Cloquet are said to have used the double-current catheter for vesical irrigation. The only rational method of litholysis is that of Dr. Hoskins, of Guernsey.

5. Spontaneous and artificial lithecboly; accidental multiple fractures of calculi in the bladder, and their crumbling from mutual or extraneous attrition very much as do those toy glass beads styled Prince Rupert's pearls, which resist severe blows with a hammer but

fly to bits after a mere scratch followed by a light tap; the chipping of the surface of some stones by strokes with a metallic instrument; were among the precursors of lithotrity. Lithoclastic cystotomy from the times of Ammonius, Franco, and the Colots; the instruments of Paré, of Sanctorius, of Fabricius Hildanus, and of Hunter to effect lithexæresis; were also accounted precursors of lithotrity. The early historians of this operation cite sundry cases as its precursors, among them that of a certain monk of Citeaux who, to destroy a stone in his own bladder, passed therein a steel rod, the distal end of which he repeatedly struck with a small mallet and thus broke off pieces of the stone which would afterward be expelled during the act of urination; that of Major Martin who used a steel instrument roughened like a file near its vesical extremity, but did not succeed in filing away the whole stone and died unrelieved; and several other cases, all of which fail to dim the luster of the discovery of lithotrity, whose evolution required such long, slow groping for light on the part of many patient laborers.

6. *The word lithotrity*—from *lithos*, stone, and *trypao*, to drill, to perforate—is still in use and will likely so continue, although bladder stones are no longer drilled as in the early times of Civiale, whilst the better term lithotripsy—*lithos*, stone, and *trypto*, to crush—is seldom employed to designate the modern operation, whose object is to crush, granulate, or whenever possible to reduce the stone to powder.*

* Among the other names given to the operation were lithoprinie, stone-catching, by Leroy, and lithomylie, stone-grinding, by Chaussier.

7. *Of the operation of lithotrity,* the earliest published scientific suggestion is contained in an essay, by the Bavarian surgeon Gruithuisen, bearing a significant title of which the following is a liberal translation:

"Should we give up the formerly entertained hope of being able, some day, to destroy bladder stones by mechanical or chemical means?" This essay appeared in the Salzburg Medico-Chirurgical Gazette for the month of March, 1813. His experiments, begun in 1809, led him to regard rectilinear catheterism with large instruments as the first requirement toward the solution of his problem, although he was not aware that this catheterism had been practised long before his time by Rameau, Lieutaud, Thomassini, Santarelli, and Lassus, by the Romans, and even much more anciently. He declared, after many trials on the dead and living, that he had had no difficulty in introducing straight glass tubes from a quarter to a third of an inch in diameter, and found it easier to pass these than curved catheters. Having satisfied himself regarding the practicability of rectilinear catheterism and the dilatability of the urethra, he proceeded to design instruments for the seizure, perforation, and fragmentation of vesical stones and for the transmission, as he believed, of a galvanic current or of chemical agents for their disintegration. These projected instruments, which were never made, appeared only in the form of drawings to illustrate his paper buried in a foreign journal and not known to the French until about ten years after its publication.

8. Fournier, of Lampèdes, is on record as having devised, in 1812, an instrument for crushing vesical stones, and as having tried it on the cadaver without, however,

going any farther. But not until the year 1828, were his labors made known.

9. Jean Civiale, while still a student of medicine, sent, in 1818, to the Minister of the Interior, a memoir which, by the Minister, was referred to the Society of the Medical Faculty of Paris. The memoir was said to be, in substance, the description and drawing of an instrument proposed for the operation of lithotomy. The committee appointed to examine the document presented no report thereon, and it was not until the year 1824 that further mention was made of the existence of the memoir, when Percy, who was in possession of the original paper, spoke of Civiale's invention, in 1818, of an apparatus suited to the dissolution and destruction of vesical stones, but said nothing of any instrument for lithotomy. This account of Percy gave rise to the bitterest controversy which lasted many years. But Civiale triumphed at last, for to him belonged the credit of performing the first lithotrity, as acknowledged by all his rivals who had attacked him so virulently ever since Percy's report and the reclamation of priority based on the 1818 memoir published in his "*Nouvelles Considerations sur les Retentions d'Urine.*"

10. There appeared in the Edinburgh Medical and Surgical Journal (1819) an article by Elderton describing and figuring a curved metallic instrument to seize and rasp a bladder stone and thus reduce it to powder. The Scottish surgeon said that he had devised the instrument two years prior to the publication of his paper. However, his method of treatment was never put into practice.

11. Amussat, when assistant demonstrator of anat-

omy, published in the "*Nouveau Journal de Médecine*" (1822), a note on the possibility of urethral catheterism with a straight tube, on the extraction from the bladder of small calculi, and on crushing the larger with a modified Hunter's forceps—unaware of Gruithuisen's work. He announced that he had performed several times these operations on the cadaver, and had so crushed stones the size of nuts. In June of the same year he presented, to the section on surgery of the Academy, three instruments; one for rectilinear catheterism, one for the extraction of small urethral and vesical calculi, and the third for the trituration of vesical stones. In his trial of the third instrument, on the cadaver, it broke in situ and was not afterward used.

12. A "*lithoprione*" was devised in 1822 by Leroy d'Etiolles, who soon confessed it to be worthless, and in 1823 presented to the section on surgery a "lithoprione-forceps" to seize and fix the stone by means of three elastic branches of equal length. Through the straight shaft was a central sliding rod with trepan-like extremity for perforation of the stone; this drill was to be operated by a small lathe adapted to the instrument. It is upon this "lithoprione-forceps" that he based his claim to priority in the invention of lithotrity. But the new "lithoprione" was not a success, as shown in its trial on the cadaver during which the vesical mucous membrane was pinched and so wedged in its branches that the instrument could neither be closed entirely nor opened when partly closed.

13. The *lithotabe*—from *litholabos*, stone forceps—was devised by Civiale in 1823. He afterward styled it *trilabe* because of its three branches, which, however,

differed from those of Leroy's "lithoprione-forceps" in being stiffer, stouter and of unequal length, and in having crochetty extremities the better to hold fast the stone. The end of the drill was trepan-like as in the "lithoprione-forceps," and the motive power the same in principle. It was with this complicated instrument that the young surgeon performed his first lithotrity, upon a man thirty-two years of age, on the 13th of January, 1824, in presence of Percy, Chaussier, Larrey, Giraudy, Nauche, Sue, Sédillot, Magendie, Serres, and Aumont. The operation was eminently successful, and the patient pronounced cured in three weeks. It required four sittings; the first was of forty minutes, the second, which was shorter, occurred eleven days after; the third was shorter than the second, and the fourth shorter than the third sitting. In subsequent operations the sittings were still shortened and sometimes greatly multiplied.

14. Percy and Chaussier presented to the Academy a report of the case and of the manner of proceeding in the operation; speaking in the most glowing terms of the skill of the young operator and of the excellence of his method which they declared to be "glorious to French surgery, honorable to its author, and consoling to humanity." This success, due unquestionably to the great skill of the operator, so impressed the lookers-on that it is no wonder the committee made such an effusive report. The brilliant operation, so highly commended, awoke many competitors who suggested as many modifications which were useless complications. But Civiale rejected them and continued to employ his method of successive perforations of the stone as preliminary steps

to its reduction to fragments small enough for spontaneous expulsion. In that year, 1824, he had lost but one case out of twelve. He then made lithotrity known in Italy through two operations successfully performed on persons of quality, and through the illustrious Scarpa who published an article commending the method after having seen him and his implements and listened to the explanation of their mechanism. Soon the method by successive perforations was adopted in Austria, Prussia, Russia, and America where it was done in 1830 by Depeyre, of New York, and in 1832, by Randolph, of Pennsylvania.

15. Heurteloup, who was one of Civiale's early competitors, left France in 1829 to take up residence in England and introduce French methods of lithotrity; performing, at the Westminster Hospital, his first operation, which was soon followed by several others; using his four branched "pince-forceps," and peculiar drill with which to hollow the stone and reduce it to a mere shell to be crushed by means of his "shell-breaker." This method not being entirely satisfactory, the ingenious surgeon paused in order to devise another set of instruments designed to destroy bladder stones with more precision and speed.

16. Meyrieux and Tanchou, in 1830, endeavored to reduce stones to powder by rasping them from the surface, but their instruments, the first with twelve, the second with ten branches, were so complicated and so liable to fracture that they as well as those of Rigal were given up as impracticable. A similar idea occurred to the late Dr. E. M. Moore, of New York, who never completed his instruments.

17. The wonder is that Civiale and some of his contemporaries should have had such marvelous success with the clumsy and complicated instruments which they used, and that the human bladder should have tolerated the violence inflicted during these operations often lasting half an hour or even longer at each of the several sittings to which the sufferers were subjected.

18. *Curved instruments*, for stone crushing, did not begin to attract general attention until ten years after that proposed by Elderton in 1819, five years after Weiss, the London cutler, had made in 1824, for Sir Benjamin Brodie, a curved stone breaker, four years after Leroy had devised, in 1825, a curved lithotrite which broke at its trial on the cadaver and was set aside, and two years after his invention, in 1827, of the lithometer. Civiale early saw that future advances would inevitably be in the line of curved instruments, and, not wishing at once to cast away his *trilabe*, began in 1829, by curving slightly its vesical extremity, and was not long in renouncing its use and in adopting the obtusely curved instrument for crushing without previously drilling the stone.

19. It was not until the year 1831 that was made known the first really practicable curved instrument, devised by Jacobsen, of Copenhagen, and styled the "articulated stone breaker," having the form of a hollow sound minus about half its circumference corresponding to the convexity of the curve, which served to lodge, when closed, three articulated segments, the first fastened to the end of the sound and the third to a steel rod that passed through the sound; this rod with its segments being moved by screw power from the distal

extremity of the instrument which, when introduced for action, was opened by pushing the rod onward to engage and seize the stone between the links and the curvature of the sound. The distal screw was then turned and the calculus crushed. The method was soon adopted in France and the instrument subjected to some modifications: one by Dupuytren, who added a fourth segment to the chain and used it on one of his patients; another by Leroy, who made provision for its easy withdrawal in case of any break in the articulations. He was very warm in his praise of the Danish instrument, declaring it destined to supersede the method by successive perforations. He soon reported fifteen successful operations out of sixteen which he had performed with this articulated stone breaker. A few months later the Academy awarded a prize of four thousand francs to Jacobsen for his invention. The fame of the stone breaker was wafted across the Atlantic in 1832 and the eminent American surgeon Randolph became its first advocate. Having begun an operation with the *trilabe*, he completed it with the Jacobsen instrument which he used in nearly all his subsequent lithotrities. Here again consummate skill rather than implement was the chief factor in the operator's success.

20. The advent of the articulated stone breaker was the first rightly directed stride toward simplification which has so invariably followed the invention of surgical instruments and methods of operating. Something simpler, of easier and safer management must necessarily come after the second, third, and subsequent forward steps; any complication constituting retrogression, or at least marring the improvement as in the following case.

21. *The percussion method* was duly attributed to the ingenious Heurteloup, who, not satisfied with the tedious successive perforations, or with his modification of the *trilabe*, or with Jacobsen's process, devised a lithotrite of another form to act on an entirely different principle from the instruments then in actual use; substituting percussion for perforation and screw pressure, and sending, early in 1832, to the French Academy of Sciences, an account of this instrument which he had named "*percuteur courbe à marteau.*" The lithotrite proper, thirty-eight centimeters in length, was of steel and consisted of two branches with short obtuse curve at the vesical extremity designated as male branch and female branch; the male sliding in a slot along the female branch. This instrument, which has served as the model for modern lithotrites, was simple enough so far as its strength and prehensile capacity went, but the manner of using it was attended with serious marring complications. When the stone was seized it was broken by sharp strokes applied with a hammer to the distal extremity of the handle and for this purpose the female branch and the patient were rendered immovable. The lithotrite being clamped to the end of a narrow rectangular table upon which the patient was strapped! Only the lithotrite survived. The rest of the apparatus was abandoned after many trials, although a hand-vice had been substituted by Amussat for the unsafe appliance fitted to the operating table. Percussion, though for some time employed by Heurteloup, Béniqué, Leroy, Amussat and others, was at length given up, but the curved lithotrite, with alterations in its jaws and handle, remained in use and screw pressure, suggested by the Danish instrument,

applied near the distal extremity of the male branch, was resorted to by Ségalas and others. Afterward the sectional nut, claimed by both Civiale and Leroy but really belonging to Charrière the cutler, was adapted to the handle to ensure the quick application and release of the screw power and so help to shorten the sittings; and finally rack and pinion pressure so much used by Sir William Fergusson and others even to the present time.

22. As early as 1832, Heurteloup had devised the spoon lithotrite which, afterward, he used in his operation of "lithocenosis" with the object of reducing the process to a single sitting, and, in 1846, published his work on lithotripsy without fragments. This and the labors of Cornay, of Sir Philip Crampton, of Mercier, of Dittel, and of Clover—each of whom had invented an aspirator to effect lithexæresis—were the forerunners of modern rapid lithotrity with immediate aspiration of the detritus, as recommended by Bigelow, of Massachusetts, under the title of litholapaxy. The Bigelow aspirator, though a very great improvement on those to which reference has just been made, was simplified by Chismore, of California, whose paper thereon appeared early in 1894.

23. The invention of evacuating catheters and of aspirators was rendered necessary for cases in which vesico-urethral obstruction was such as to impede the spontaneous expulsion of the fragments. Even with these aids it is often difficult to ensure the outward passage of the last two or three fragments too large to enter the lumen of the evacuating catheter. Provision has been cleverly made for this by Bryant, of New

York, who devised an evacuating catheter and lithotrite combined and designed to crush such fragments as they are drawn by aspiration into the grasp of the lithotrite's jaws.

24. Time and space will scarcely permit the specification of the very great numbers of modifications made in the blades and other parts of the lithotrite from the model given by Heurteloup to the instruments used at present in Europe and America. These blades have received scores of different forms. The slot in the female shaft and the dovetailing of the two shafts have been much varied. The handle too has undergone as many changes in form, and the modes of operating the sectional nut have been greatly multiplied, but the true principle of screw pressure is unaltered.

25. The modern lithotrites regarded as the best and safest and most efficient are the fenestrated, for fragmentation of hard and large stones, and the flat-bladed, for the smaller, more brittle, and softer stones; the male blade being the narrower, in these, for granulation and pulverisation. Stones which resist the fenestrated instrument not being adapted to the crushing operation are removed by incision above or below the pubes.

26. Formerly the curved lithotrites were so subject to distortion or even to fracture, when used to crush hard stones, that greater care in their construction has since been taken, and breaks or other accidents are now of extreme rarity.

27. The essential characters of a good lithotrite are strength and lightness. The shaft is a little smaller than the beak which at its largest part is seldom more than twenty-four millimeters in circumference, and the

average weight is about two hundred and seventy grammes. Any lithotrite weighing more than three hundred grammes by reason of length and thickness may be regarded as too heavy and clumsy for delicate handling. Heavy lithotrites of large caliber are of difficult introduction and apt to do serious injury to the urethra.

28. Permit again the statement, so often iterated, that lithotrity, in any form whatsoever, is not likely ever to take the place of lithotomy; each of these methods of treatment having its adaptations, so, when one is indicated the other is surely contra-indicated.

29. The aggregate results of lithotrity operations with curved instruments from the year 1840 to 1870, were one death in 9.82 cases; the best being one death in 16.57, and the worst, one in 5.08 cases. The mortality has since been reduced to five and even to less than five per cent. In the writer's practice it was one in twenty, whilst that from cutting operations was one in ten.

30. As did lithotomy, so has lithotrity done much toward a better understanding of the anatomy of the urinary organs, and of the nature and treatment of their affections. The discovery of the high degree of dilatability of the urethra so essential to the proper performance of lithotrity with the primitive instruments of large caliber, and for the spontaneous expulsion of the detritus; the keener appreciation of the true nature of urethral strictures and of their treatment by dilatation and by internal and external incision; the real nature and the treatment of prostatic enlargement; the detection of vesical tumors; and the extraction of certain foreign bodies from the bladder without external incision; were

some of the surgical advances incited by the invention of lithotrity.

31. Among the early opponents of this operation there were, for several years, rumors of a coming fierce war against the method and its supporters. The chief of those who assumed neutrality or pretended to fairness was Blandin, who in his "Thèse de Concours" (1834) on the parallel of lithotomy and lithotrity, though acknowledging the invention of lithotrity to be a happy surgical conquest, expressed his conviction that the successive perforations and the crushing of stones were not equal to lithotomy; this conviction, he said, being based on the fact that the mortality from lithotrity was greater than that from lithotomy. Leroy's paper, on the crushing operation as applied to children, presented to the Academy of Medicine in Sepember, 1834, was, to the dissenters, the signal for a determined assault on lithotrity and on its advocates. Early in 1835, the attacking party was headed by Velpeau whose denunciation of the method was bitter in the extreme and who finally declared that the surgeons of the future would surely be of his way of thinking on the subject in contention. The defenders spoke their word during the several stormy meetings of the Academy, but neither party in the controversy appeared, at the time, to have gained much ground toward carrying general conviction. Afterward, however, the defenders recruited their forces, and lithotrity rapidly gained in strength and practically won the field before the year 1835 had expired. But in the course of another decade the contest, which was renewed by Velpeau and his followers, ended in complete victory for the defenders. After these many years

of militance, and despite the protestations of the few who would not be convinced, it was decreed, by the profession at large, that lithotrity was not to be regarded as the exclusive mode of treatment but as a precious additional resource of surgery in certain cases where lithotomy was not warranted and where the indications of a knifeless operative procedure were clear.

32. The names of those pioneers who labored so assiduously to place lithotrity on a firm scientific basis are well worthy of permanent recordation and of thus being always before the eyes of all future generations of surgeons who will surely receive the most wholesome inspirations from the perusal of the works of these eminent men among whom were Civiale, Amussat, Leroy, Heurteloup, Brodie, Jacobsen, Ségalas, Mercier, Crichton, Fergusson, Keith, Thompson, and Guyon, who, together, have established the soundest and most endurable principles for the guidance of students of lithotrity. Their worthy chief Civiale had had the wit to avail himself of all the real improvements made by his contemporaries, although his own devices were generally the best. His opportunities for investigation were indeed very great and he made the most of them. His valuable contributions to the literature of diseases of the urinary organs, particularly of calculous affections, greatly exceeded those of the writers of his time. The acknowledged dean of the lithotritists of the world, he lived to a ripe old age to enjoy the glorious fruits of his labors and the blessings of many sufferers.

33. It can scarcely be denied that lithotrity, as it now stands, is honorable to that master and his many emules, glorious to surgery, and consoling to humanity.

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